PRACTICAL
ENGINEER

VOL. XIV. CHICAGO, AUGUST, 1910. No. 8.

POWER IN A PACKING HOUSE

COMPLETE AUTOMATIC EQUIPMENT TO INSURE UNINTERRUPTED AND ECONOMICAL SERVICE

WHILE THERE HAS BEEN a great deal of agitation about the high price of meat during the past year, and many causes for this condition have been brought forth, so many, in fact, that almost nobody connected with the packing industry, from the farmer to the retail butcher, has not been accused of undue profit in some form, there is, however, one class of men free from accusation of the public. Engineers and mechanics have done everything in their power to lower the price of meat by lessening the cost of labor to handle it from the live stock in the yard to the dressed meat on the butcher's block. These men have worked together with superintendents and managers to develop the present system of butchering by machinery, which is rapid, efficient, sanitary and employs but a small percentage of unskilled labor.

In the stock yards at Chicago, a new packing house has just been put into operation by Miller & Hart, Inc., an independent packing company which handles only pork products. The power plant of this packing house furnishes everything needed in the power line, and though not large has a number of interesting features which make it a model for this class of work. Light, heat, refrigeration and power are all supplied from one power plant which is located in a separate building from the main packing house.

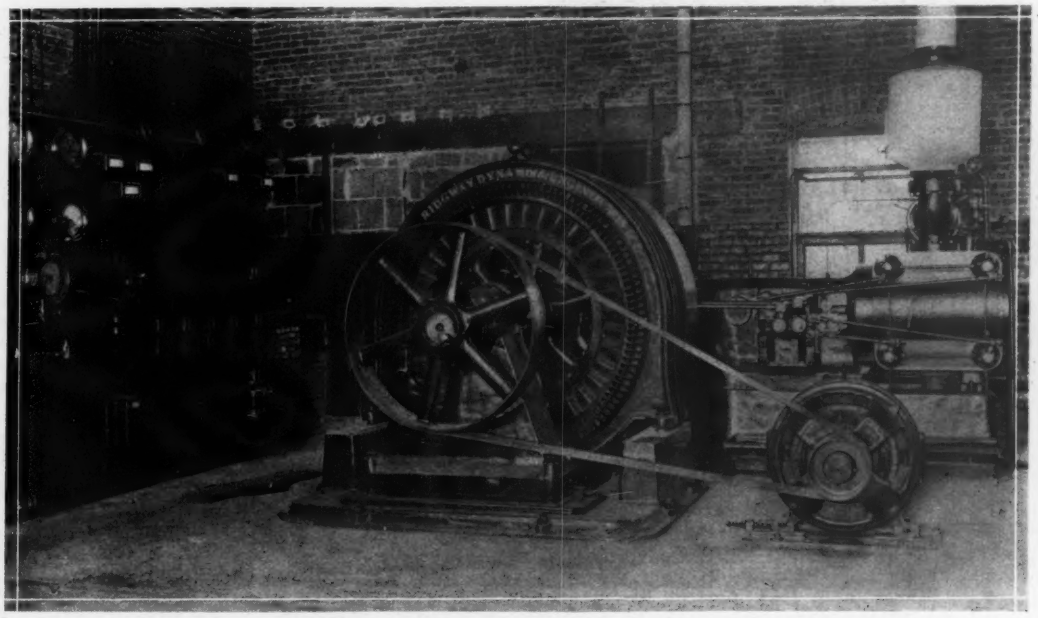


FIG. 1. GENERATING UNIT AND SWITCHBOARD IN MILLER & HART PLANT

Engine Room

IN the engine room are located the electric generating unit, all of the refrigerating equipment which requires close attention, and the house and fire pumps.

Besides this equipment space has been left in the engine room for the addition of other electrical and refrigerating machinery to be installed when the needs of the plant require the extension. The generating unit now in place is a 4-valve automatic engine direct connected to a generator, the entire unit being made by the Ridgway Dynamo & Engine Co.

The engine has a single cylinder 18 by 18 in., and is rated at 250 hp., running noncondensing at 225 r.p.m. The steam pressure carried is 150 lb., steam being conducted to the engine through a 7-in. pipe, and the exhaust led to an open feed-water heater through a 10-in. pipe, except when the steam is used

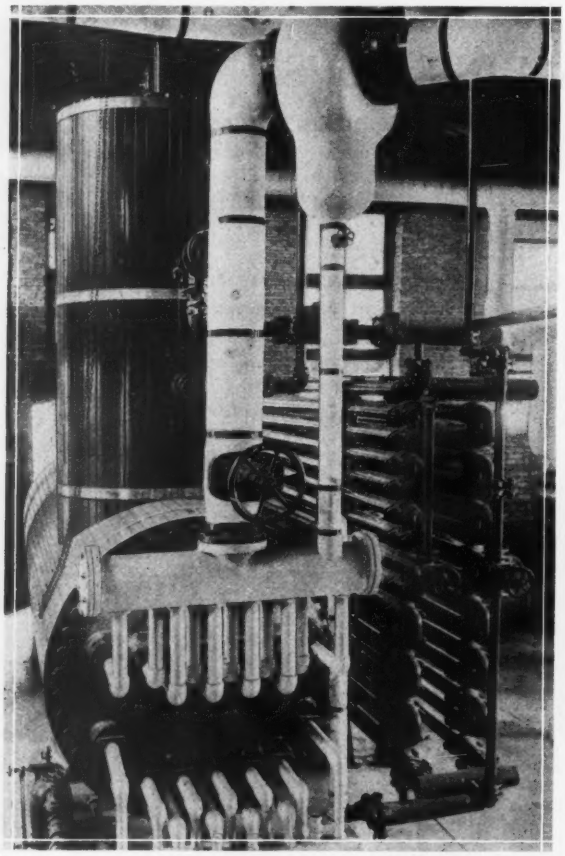


FIG. 2. GENERATOR, ANALYZER AND EXCHANGER

for heating, when it first goes through the heating system which carries a back pressure of 5 lb.

The steam valves are of the double-ported semibalanced, Corliss type, giving ample port opening with small travel at all points of cutoff. They work in removable cages of hard, close-grained cast iron, and are ground or lapped to a perfect fit, insuring steam tightness. The exhaust valves are of the Corliss type, double ported and semibalanced. The steam valves are driven by the governor eccentric through an accelerating gear located in a cast-iron case on the side of the bed and immersed in oil.

Motion from this gear is transmitted direct to the arms on the valve stems. The accelerating gear consists of a simple combination of arms and links having adjustable bearings. This gear gives rapid motion to the valves at the time of opening and closing, but allows them to remain stationary during the unbalanced period. The exhaust valves are operated by a wristplate motion from a fixed eccentric on the main shaft and also have slight movement during the time when the pressure thereon is heavy.

All valve gear bearings are lined with adjustable and removable bronze bushings, and those outside of the gear case are lubricated by compression grease cups.

The governor is of the inertia type mounted within the flywheel. The inertia bar is carried on a large roller bearing fitted with hardened steel bearing pin and bushings. The eccentric and strap are split so that they may be removed without disturbing the shaft or governor. The strap is lined with babbitt pened and bored and provided with means for ample lubrication. This governor is powerful and sensitive, but sudden and extreme movements of the inertia bar are dampened by dash pots.

The connecting rod is a single forging of open hearth steel of the solid end type. The wrist pin boxes are of phosphor bronze of the split box type and the crank pin boxes are of the same type lined with babbitt. The adjustment at both ends of the rod is by wedge blocks securely held by 2 bolts.

The crosshead body is cast steel of ample size and strength. The shoes are of cast iron lined with babbitt metal; the lower shoe being adjustable without the use of liners. The piston rod is connected to the crosshead by a long thread and jamb nut, securely locked in place. The wrist pin is fitted to the crosshead body by a long taper at each end and is made of hardened steel. This pin is arranged so that it may be turned 90 degrees as it wears.

The entire unit has only 2 main bearings, which are of the ring oiled type, and the crank and crosshead are enclosed, which permits of splash lubrication of these parts. The engine is equipped with a Hills-McCanna lubricator and a Cochrane steam separator, which insures the use of dry steam. Another convenient feature is a turning-over device which consists of a lever and ratchet, and enables a man to turn the flywheel over easily. Other conveniences are attached to this engine, such as a bypass pipe and valves for starting and indicator connections and cock, which are thoroughly appreciated by operators.

As stated above a Ridgway alternator is mounted upon the same shaft as the engine. The generator is of the revolving field type, wound for 3-phase currents at 60 cycles, and generates current at 450 volts. It has a rating of 156 kv. a.

The exciter was also made by the Ridgway Dynamo & Engine Co., and is run by a belt from the engine shaft. It generates direct current at 125 volts, running at 750 r.p.m. and is rated at 15 kw. to carry 120 amperes.

Switchboard

FOR controlling the power used about the packing house, a 4-panel switchboard is employed which is a standard make of the General Electric Co. It is made of marble with a black finish and is equipped with 6 circuit breakers, 3 ammeters, 1 voltmeter, 1 powerfactor meter and a wattmeter. The motors used about the packing house are of the induction type, wound for 440 volts, and transformers reduce the voltage to 110 for supplying the incandescent lamps.

A separate panel is mounted on the switchboard frame, which contains the gages used in the refrigeration system and also the steam gages. Those gages used

for indicating pressures in the refrigeration system were made by the Star Brass Manufacturing Co., and indicate the generator, cooler, absorber and exhaust steam pressures. A live steam recording gage made by the Crosby Co., is mounted upon this panel as is also an Ellison differential draft gage, made by Louis M. Ellison.

Refrigerating Outfit

IN order that meat, after it has been dressed, may be properly ripened, it is necessary that it be cooled rapidly and kept at a low temperature for a definite length of time. To do this in large quantities requires a great deal of refrigerating power, and this plant has been generously equipped in this direction.

The entire refrigerating outfit was supplied by the Carbondale Machine Co., and employs the absorption system. The equipment is for 100 tons of refrigeration, and the system employs only the exhaust steam from the pumps, which are used to circulate the ammonia and brine, for heating the generator. For this reason the pumps are run with a back pressure of 20 lb., and special provision is made for supplying the generator with live steam through a Foster reducing valve, which brings the steam down to 20 lb. from the house steam mains which are supplied at 80 lb. pressure, in case it is found that the steam from the pumps is not sufficient to supply all the needs of the generator.

The generator, analyzer, exchanger, aqua-ammonia receiver, brine cooler, anhydrous receiver and pumps are all located in the engine room. The other equipment consisting of a rectifier, weak liquor cooler, condenser and absorber, are placed on the roof of the power house.

A welded steel generator rated at 100 tons refrigeration is employed, and directly over this is located the analyzer. As will be noted in the photograph a double pipe exchanger is employed which is placed beside the generator. The brine cooler is of the shell type, and is rated at 100 tons. This type consists of a steel shell inside of which is placed a coil of pipes through which the brine is pumped, the pipes being surrounded by the cold ammonia gas.

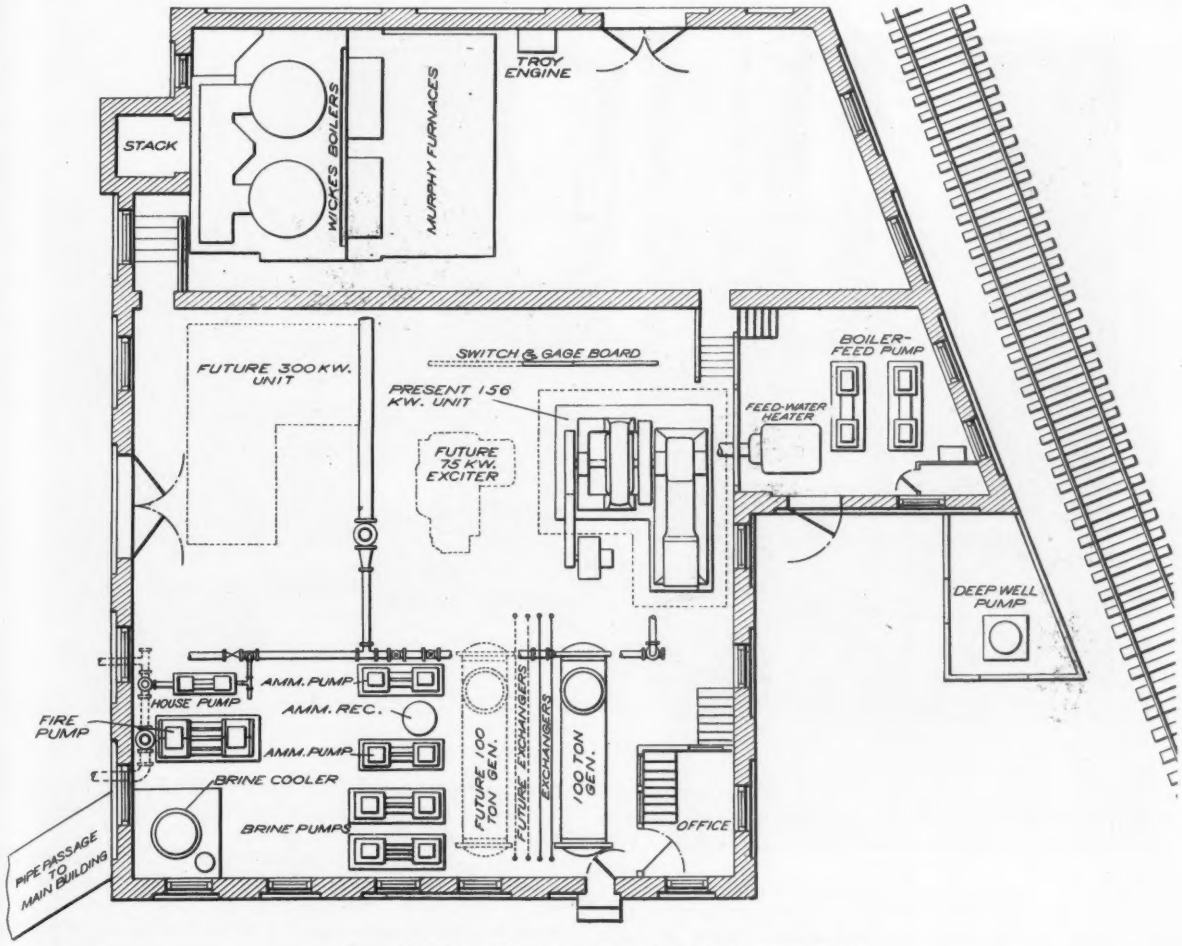


FIG. 3. GENERAL LAYOUT OF THE MILLER & HART PLANT

The ammonia condenser, which, as stated before, is located on the roof of the power house, consists of 16 stands of pipe, 12 pipes high. Directly beneath the condenser is the absorber which consists of 16 stands, 14 pipes high. These are both of the atmospheric type, and the water used for condensing the ammonia is allowed to drip over the absorber, thus serving a double purpose. All this apparatus is covered by a roof and enclosed by open wood work which permits a free circulation of air.

Cooling water is taken from the artesian well and is originally about 56 deg. in temperature. After it has served the purpose of condensing, it is used to

flush the floors of the packing house, or may be used for feeding the boilers.

One of the most interesting features of the plant is the brine system which extends over the entire building and is used for cooling the fresh meat and keeping the temperature of the refrigerating rooms down to the proper point. Calcium brine is used for this purpose, and is conducted through a pipe that is galvanized on the outside. Where not intended for cooling purposes all brine piping is thoroughly insulated to prevent radiation. A feature which is of great advantage in handling the brine is the provision of an equalizing brine tank, which is located upon the top floor of the building. This does away with all air binding, and returns the brine to the pumps direct, under a considerable pressure, thus the power required by the pumps is only that necessary to overcome the friction of the system.

Another noteworthy provision is that of a brine storage tank, 7 by 30 ft., which is thoroughly insulated, and used for storing the cold brine which is kept ready to pump through the refrigerating system in case of any accident to the generator or ammonia end of the refrigerating outfit. This tank has capacity sufficient to keep the temperature of the system down to the required point for about 6 hr.

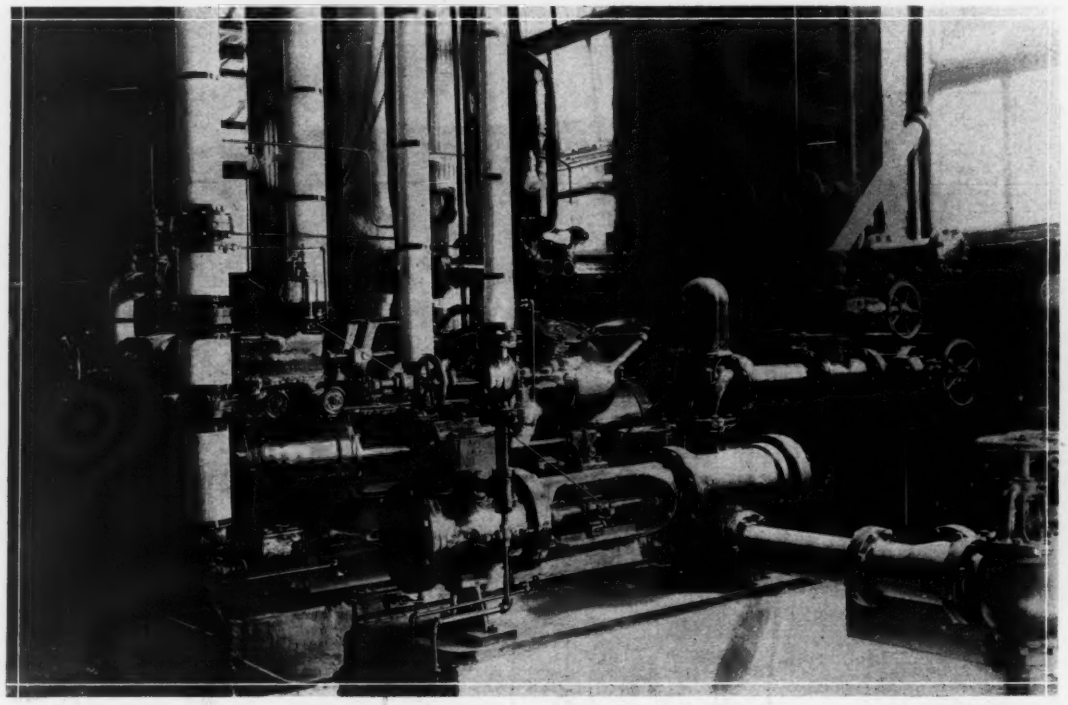


FIG. 4. HOUSE AND FIRE PUMPS

Pumps

PUMPS used in the refrigerating system consist of 4 Canton-Hughes single-acting pumps, 2 of which are used for handling the aqua-ammonia, and 2 for circulating the brine, all equipped with Detroit lubricators. The ammonia pumps are 16 by 6¾ by 14 in., and are supplied with steam at 150 lb., exhausting at 20 lb. pressure. The pressures carried on the ammonia line are 15 and 125 lb. These pumps are equipped with automatic ammonia regulators, which maintain a constant level of aqua-ammonia in the receiver.

The brine pumps are 14 by 12 by 18 in., using steam at pressures the same as the ammonia pumps, and discharge the brine at 40 lb. pressure. The pumping equipment of the plant is double that required for the rating, but this extra provision was thought advisable to protect the plant against a shutdown. Since all pressures carried in the refrigerating system are comparatively low, it is only through the failure of a pump that a shutdown is liable to occur.

Located in the engine room is also a 1000-gal. fire pump, which is of the duplex type made by the Canton-Hughes Pump Co., with cylinders 16 by 9 by 12 in. A constant pressure is carried upon this pump of 80 lb. per sq. in., which can be increased to anything desired in case of necessity. The pump is equipped with a regulator made by Foster Engineering Co., and a Hills-McCanna oil pump.

Also located in the engine room is the house pump of the single-acting type made by the Canton-Hughes Pump Co., with cylinders 10 by 9 by 12 in. This pump is also equipped with a Hills-McCanna oil pump.

In a separate pump house is located the deep well pump, which draws water from a well 1650 ft. deep with a diameter of 5 in. at the bottom. The pump was made by the Canton-Hughes Pump Co., with 12 by 36-in. steam cylinder, and 7½ by 36-in. water end. It has a capacity of 300 gal. per min. and is double acting. The water piston is placed 170 ft. below the surface of the ground.

Boiler Room Equipment

THE present steam generating equipment consists of 2 vertical water-tube boilers made by the Wickes Boiler Co., rated at 250 hp. each, and carrying steam at 150 lb. This type of boiler consists of 2 cylinders joined together by straight, vertical water tubes which are divided into 2 equal compartments by a fire-brick tile. The entire boiler is supported

by 4 heavy pressed-steel lugs with wide faces, riveted to the sides of the mud drum, which rest upon steel plates placed upon the foundation. The steel plates are perfectly leveled before the boiler is put into place, and when erected the boiler stands vertical, independent of the brick work which entirely surrounds it and is free to expand and contract without any interference.

The steam and mud drums are of the same diameter, in this case being 78 in., the lengths however are different, that of the steam drum being 100 in. and of the mud drum 53 in. Each drum is provided with a man hole and several hand holes, an arrangement which permits entering the boiler at the highest and lowest points from which an inspection of the interior of the boiler can be made and the tubes easily and thoroughly cleaned.

There are 112 water tubes connecting the mud and steam drums. The tubes are 4 in. in diameter and 21 ft. long, arranged in parallel rows from front to

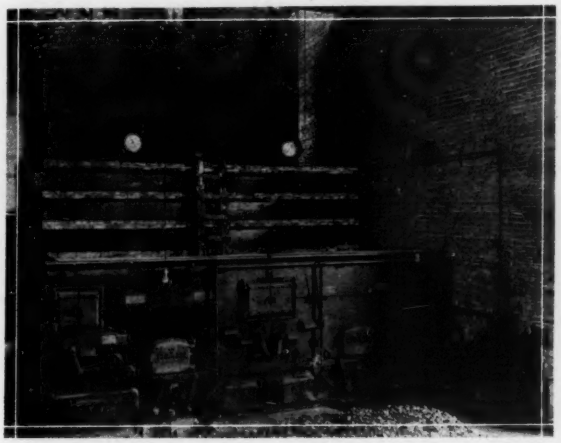


FIG. 5. FURNACES AND BOILERS IN MILLER & HART PLANT

rear with space enough between to admit a small hoe for removing soot which may fall upon the tube sheet of the mud drum.

The water line is maintained in the steam drum at a sufficient height above the tubes to insure complete submersion. To prevent spray from being thrown into the steam space and to deflect the current of water, a baffle plate is placed at the water level extending over the tubes in the front compartment.

Each boiler is equipped with a Wright safety water column, a Murray automatic feed-water regulator and a Crane safety valve. The blowoff pipes are each provided with 2 blowoff valves in series, one being a Crane asbestos-packed, the other a Homestead Straightway valve.

The steam header which conducts the steam from the boiler to the engines and pumps is a 12-in. pipe, thoroughly insulated with magnesia sectional covering. The flue gases are discharged through a guyed steel smoke stack, 5 ft. in diameter and 125 ft. high. The boilers are equipped with Murphy automatic furnaces, which are operated by a Troy 2-cylinder automatic-cutoff engine. At present coal is fed to the furnaces by hand, but as the plant is enlarged provision will be made for doing this work with conveyors.

Feed Water Supply

FEED water supply is taken principally from the city mains, although provision is also made for using the well water. All water fed to the boilers is passed through a 750-hp. Cochrane open feed-water heater located in a separate room on a floor 7 ft. below that of the engine room so that all condensation drains to the heater. All exhaust steam from the engine and feed-water pumps is piped to the heater which is of the latest type manufactured by the Harrison Safety Boiler Works, provided with a Cochrane oil separator and safety cutout valves which insure protection to anyone working in the body of the heater. The generator of the refrigeration system is drained by an Anderson high-pressure trap, from which the condensation goes direct to the feed-water heater.

From the heater, the water is pumped to the boilers by 2 boiler-feed pumps made by the Canton-Hughes Pump Co. These are outside packed, double-acting pumps with cylinders 10 by 10 by 12 in. Each pump is provided with an automatic pump governor, and the boilers are equipped with Murray automatic feed-water regulators, which makes the system entirely automatic.

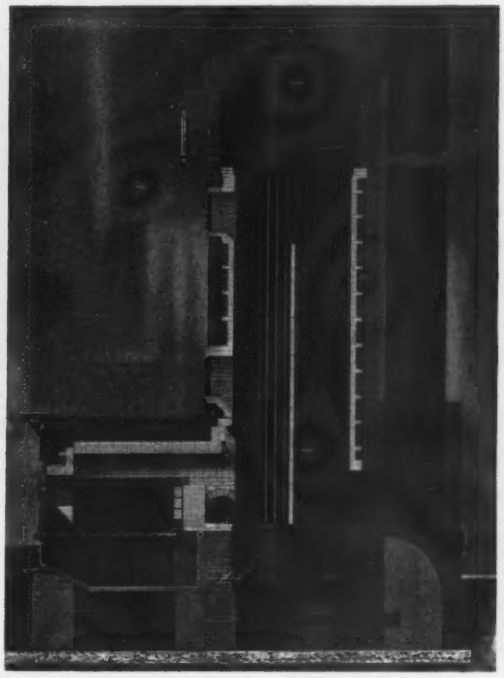


FIG. 6. SECTIONAL VIEW OF WICKES BOILER EQUIPPED WITH MURPHY FURNACE

On the feed lines to the boilers Jenkins Bros., stop valves are employed, and on the steam supply line to the pumps, Osborne plunger throttle valves are used. The discharge pressure of the pumps to the boilers is about 160 lb. per sq. in.

All steam pipe lines are thoroughly insulated with magnesia sectional coverings made by Keasbey & Mattison Co., to prevent radiation of heat, and loss of power. The steam pipe lines are also provided with Anderson emergency steam traps wherever it was thought necessary. Foster reducing valves are employed about the plant as follows: One for reducing the steam from 150 to 80 lb. pressure to be

used about the house for pumps and various other apparatus. Another reduces the steam from 150 to 40 lb. for cooking purposes. The third, which was mentioned above, reduces the steam from the 80 lb. pressure line to 20 lb. pressure and is used when additional steam is needed for the generator of the refrigeration system.

In the house 3 lard and 3 grease and drying tanks are employed in the purification of grease and for drying offal. Steam from the engine room is used for heating these tanks and for draining them of condensed steam 2 Fairbanks-Morse vacuum pumps are employed.

As already stated, this packing house is not considered large in comparison with the houses operated by the meat trust firms, yet it has a capacity for butchering 750 hogs a day, and taking care of the entire products. A distinctive feature of the plant is that it is equipped throughout with an overhead rail system which does away entirely with the use of trucks. The electric power used is for running elevators, hog scrapers and the like, while all pumps are steam driven. The chief engineer of the plant is J. H. Burton, to whom is due the completeness of the equipment and the convenience of the plant which goes far towards securing economical operation.

BOILER FEED PUMPS

By N. G. Neer

MANY superintendents and engineers when buying a boiler feed pump leave the proper size to be determined by the salesman, for the reason that they have never gone into the matter and ascertained the basis on which the proper size of pump is determined. It is a very simple matter and the following explanation may be of interest. An engineer generally knows his boiler by the horsepower for which it is rated. One horsepower as referred to a boiler is generally understood to mean the evaporation of 30 lb. of water per hour from a feed water temperature of 100 deg. into steam at 70 lb. pressure.

The amount of water which a boiler will turn into steam depends upon, among other things, the steam pressure carried on the boiler and the temperature at

TABLE I. WATER REQUIRED AT DIFFERENT TEMPERATURES OF FEED WATER

TEMP. OF FEED WATER	LB. OF FEED WATER PER H.P. PER HOUR	GALLONS PER MIN. PER 100 H.P.	PERCENT ALLOWANCE FOR SLIPS ETC.	GALLONS FEED WATER PUMPED PER MIN. FOR EACH 100 H.P. OF BOILER
70	29.04	5.81	10	6.39
100	29.82	5.99	10	6.59
150	31.22	6.36	10	7.00
180	32.14	6.61	10	7.27
200	32.77	6.79	10	7.47
212	33.17	6.91	10	7.60

which the feed water is introduced into the boiler. The pressure makes, at 100 lb. pressure, but little difference, there being but about 1 per cent variation between 100 and 150 lb. steam pressure, therefore it will not be far out of the way in any case to make all estimates on the basis of 100 lb. steam pressure.

On the other hand the temperature of the feed water is an important factor and should be taken into account for any close calculations. The amount of feed water required if it were supplied to the boiler at a temperature of 212 deg. would be determined as follows, using the factor's of evaporation as given in Kent's handbook:

Factor of evaporation for 100 deg. temp. to 70 lb. pressure (standard rating).....1.1497
Factor of evaporation for 212 deg. temp. to 100 lb. pressure 1.0397

$$30 \text{ lb.} \times \frac{1.1497}{1.0397} = 33.17 \text{ lb. feed water per hp. per hr.}$$

Table I, calculated on the same basis, gives the amount of feed water per horsepower per hour required for varying conditions of feed water temperature, evaporated into steam. Where the temperature

TABLE II. FEED WATER REQUIRED FOR DIFFERENT SIZED BOILERS

HP. OF BOILER	GAL. FEED WATER REQUIRED PER MIN.	HP OF BOILER	GAL. FEED WATER REQUIRED PER MIN.
50	3.75	1000	75.
100	7.50	1200	90.
150	11.25	1500	112.50
200	15.	2000	150
250	18.75	2500	187.50
300	22.50	3000	225
400	30.	4000	300
500	37.50	5000	375
600	45.	6000	450
750	56.25		

of the feed water is not known it is fair to assume that 212 deg. will cover the maxium for ordinary installations, and therefore a pump will have ample capacity if figured on the basis of 7.6 gal. a minute for each 100 hp. rating of boiler capacity; in as much as the

TABLE III. SPEEDS OF BOILER FEED PUMPS

LENGTH OF STROKE	STROKES PER MIN. EACH PISTON	PISTON SPEED FT. PER MIN.
3	80	20
4	70	23
5	60	25
6	50	25
8	40	27
10	37	31
12	35	35

above figures allow 10 per cent for slip we will not be far wrong, and it will simplify calculations and make it easier to remember if we call it even figures and say 7½ gallons (or one cubic foot) of water for each 100 hp. Table II is calculated on this basis.

TABLE IV. SIZE OF DUPLEX BOILER FEED PUMPS

SIZE OF PUMP			STROKES PER MIN. EACH PISTON	GALLONS PER MINUTE DISPLACEMENT	BOILER HP. THAT PUMP WILL SUPPLY
DIAM. STEAM PISTON	DIAM. WATER PISTON	LENGTH OF STROKE			
3	1⅞	3	80	3.68	50
3	2	3	80	6.56	85
4½	2¾	4	70	14.4	190
5¾	3½	5	60	25	330
6	4	6	50	32.6	430
7½	4½	6	50	41.3	550
7½	5	6	50	51	700
7½	4½	10	37	51	700
7½	4½	12	35	58	800
8	5	10	37	63	850
9	5¾	12	35	79	1100
10	6	10	37	91	1200
10	6	12	35	103	1400
12	7	12	35	140	1850
14	8½	12	35	206	2750
16	10½	12	35	315	4200

There are certain sizes of pumps which are in such general use that they may be called standard for boiler feeding service. These sizes, the length of stroke and the ratio of cylinders, vary somewhat among the different makes. There is also a slight variation in the speed ratings. It is desirable to run a pump somewhat slower on boiler feeding than on general service because it generally handles hot water, it operates continuously and a slow speed prolongs the life of the pistons, valves and packings, and furthermore, it must have a reserve capacity and be capable

of being speeded up on occasion to deliver an amount of water considerably in excess of the average amount required.

A fair, conservative rate of speed for the different lengths of stroke of steam pumps is about as shown in Table III. This gives a rating for the different trade sizes of pumps which agrees well with an aver-

TABLE V. DIMENSIONS OF SINGLE CYLINDER PUMPS FOR FEEDING BOILERS OF VARIOUS RATINGS

SIZE OF PUMP			STROKES PER MINUTE	GALLONS PER MINUTE DISPLACEMENT	BOILER H.P. THAT PUMP WILL SUPPLY
DIAM. STEAM PISTON	DIAM. WATER PISTON	LENGTH OF STROKE			
3	2	5	60	4.2	55
3½	2¼	5	60	5.4	70
4	2½	5	60	6.6	90
4¼	3	5	60	9.0	120
5	3¼	7	45	11.2	150
5½	3¾	7	45	15.7	210
7	4¼	8	40	19.6	260
7	4⅞	10	37	25.5	350
7½	5	10	37	31.4	425
8	5	12	35	35.7	475
10	6	12	35	51.5	700
12	7	12	35	70.0	950
14	8	12	35	91.0	1200

age of the ratings as given by the leading manufacturers, and an engineer can select a pump from Tables IV and V with the assurance that it will be of ample size for the horsepower of boilers as stated in the table.

VALVE BRONZE COMPOSITIONS

By Wm. H. Wonfor

ENGINEERS, buying a valve or receiving a visit from a valve salesman, are often told a lot of things which they put down as "hot air" because the reasons for such statements are not given. They are told that the composition of a certain valve is too soft, that another composition will not wear, and there are other variations of the same thing that would lead the average man to believe that the making of a valve was a case of guess work and that there were no rules to work under as is the case in every other branch of engineering. Such a proposition is as far from the facts as any statement could be.

A valve to give results must follow certain conditions. Each metal that enters into the composition is put there for a certain purpose and any more or less portion than the exact quantity forms a composition that is entirely different from what it started out to be.

There are 4 metals that enter into valve bronze: copper, tin, zinc, lead.

Copper is a tough, malleable and ductile metal with a melting point of 1050 deg. and, next to silver, the best conductor of heat. In dry air it undergoes no change, but in moist air it becomes covered with a film of basic carbonate of copper. It is an important element in brass, bell metal, gun metal, bronze, German silver, platinoid and other alloys that are used in many kinds of manufactured articles.

Tin is a white metal which melts at 232 deg., but becomes brittle at 200 deg. Tin is not oxidised in air at the ordinary temperature but is easily oxidised on heating it in air or oxygen; the dioxide is formed on complete oxidation. Tin also enters into many important alloys.

Zinc is a white metal with a faint bluish tinge; melts at 419 deg. and boils at about 920 deg. It is most ductile and malleable between 100 and 150 deg., while over 200 deg. it becomes so brittle that it can be powdered. In the air the metal becomes superficially coated with carbonate, and then undergoes no further change. When strongly heated in air it burns with a bluish white flame to the oxide. It enters into the important alloys.

Lead is a silvery white metal when chemically pure, which quickly tarnishes in the air, owing to slight superficial oxidation. Lead melts at 618 deg.

These 4 metals when proportioned into 87 per cent copper, 7 per cent tin, 1 per cent lead and the balance zinc form the composition known as valve bronze as adopted by the Bureau of Steam Engineering, Navy Department, as standard after many years of experiment and testing. This composition will be referred to in this article as Navy bronze.

The base of the alloy is copper and in Navy bronze a standard is set that indicates the kind of copper or its equal that is to be used, and which must in some instances show that it is 99.5 per cent pure. In the analysis of the final alloy no component varying more than 1 per cent in amount above or below that specified, is allowed.

Tin is used to harden and toughen the alloy. Without its use, or in insufficient quantity, the alloy lacks the necessary texture or tenacity to resist the working of the steam or other force that the valve controls.

Zinc is used as a binding material and for its mechanical action in mixing with the other ingredients, and bringing their particles into closer union. In the chemical action that is set up in the furnace, the heat almost entirely evaporates the zinc and it goes off with the other gases that flow out of the furnace.

Lead is used for mechanical reasons only, without its use the alloy would be hard to handle in the final machining of the article. An excess of lead would make a composition that would be easily handled in the final processes of manufacture but unsatisfactory from the user's viewpoint, as the continued heat of a steam line would tend to break down the composition of the alloy because of the lack of resistance to this continued heat that the lead affords.

An excess of zinc also has the same action on the composition and, while the portion of the zinc that goes out of the mixture in the form of gas is allowed for in the composition, an excess of this metal will remain in the alloy and will have the same action as an excess of lead.

The chemical melting point of the various metals is in a measure misleading to the layman. While the melting point of copper is given as 1050 deg., it requires a considerably higher temperature to bring copper to a degree of heat that it will pour in a semi-liquid mass into the moulds. Experiment has shown that at least 2300 deg. is required to obtain the best results from the Navy-bronze mixture in the formations of clean castings.

In the preparation of Navy bronze the copper is placed in a crucible and submitted to the heat required to bring it to a desired temperature so that it will assimilate the other 3 metals. When this temperature is reached the tin, zinc and lead (or white metals as they are called in the foundry) are added and the whole mass is then submitted to a further heat at a specific temperature that the intermixture of the various metals is thorough and complete.

After a certain lapse of time the alloy is poured off into the moulds and, if carried out successfully, the result is a casting that can be machined properly and will give the user the desired service.

Do not shake off or avoid your work; do not go around obstacles—go through them.—Marden.

THE FUEL ECONOMIZER

LOCATION IN POWER HOUSE

By Carl S. Dow

An economizer must be placed between the boilers and the chimney or stack. This does not mean that it must literally be wedged between the 2 pieces of apparatus, but that it must be between them as regards the travel of waste gas. Considering this fact, it is quite evident that the economizer should be located as near to the boilers and chimney as possible so that the cost of flues will be reasonable.

In planning a new power house, it is comparatively easy to locate the economizer properly, provided that the owners are not too anxious to save every dollar possible in initial cost and the architect can be made to appreciate a few facts well known to every operating engineer and fireman. To locate an economizer to the best possible advantage in a power house not originally laid out for this apparatus is not often an easy matter unless considerable expenditure is allowed. The expenditure should, however, be considered advisable in most cases because of the advantages which result from doing the thing correctly.

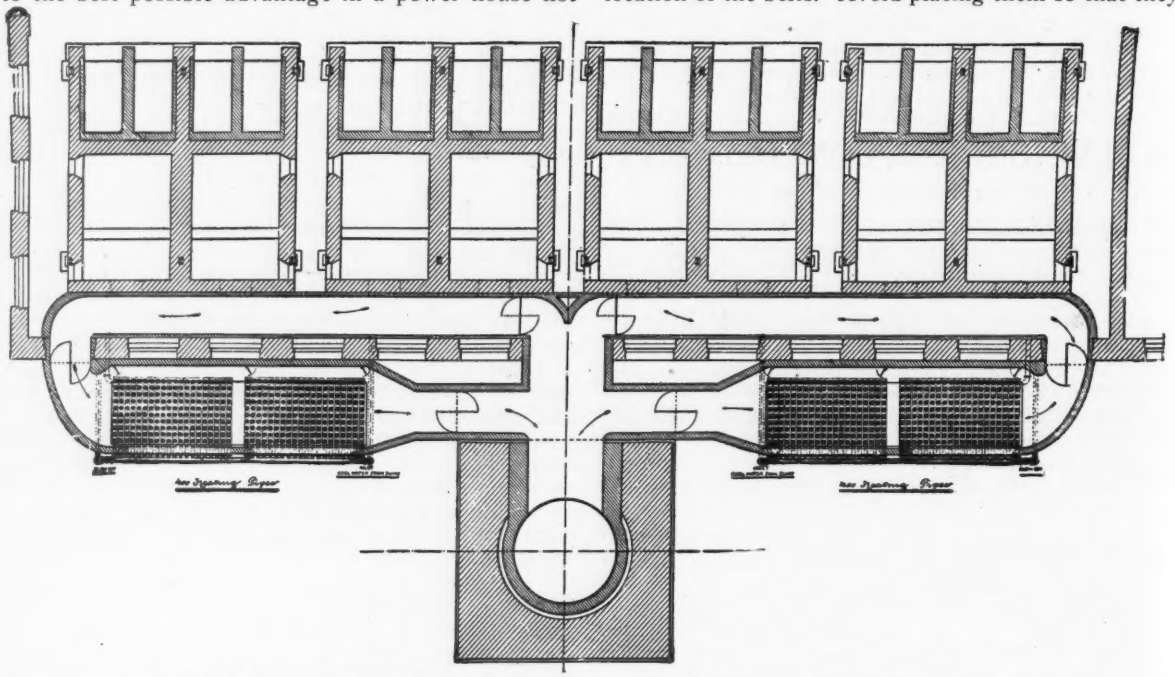


FIG. 1. ECONOMIZERS IN THE POWER PLANT OF THE RHODE ISLAND SUBURBAN CO.

In selecting the place for the economizer several things must be borne in mind. The bypass flue must be provided for; this is usually beneath or beside the economizer. As the economizer pipes are 9 or 10 ft. long, this amount of room at least is needed above the top of the economizer in order that the pipes may be cleaned and repaired. The best efficiency can never be obtained, if the place in which work must be done is hard to get at and next to impossible to work in. Thorough work is seldom done in dark corners where discomfort is unavoidable and the only light is a smoky torch. An economizer will never be well cared for and kept in efficient operation if above it there is hardly head room enough to attend to the scraper mechanism and certainly not enough to clean or take out a pipe.

In the same way that space at the rear of boilers and around pumps is desirable, so air and light are exceedingly desirable around an economizer. It is usually considered warm on top of boilers; but the heat is liable to be far more intense above an economizer, if the architect fails to provide adequate ventilation. Another reason for ventilation is the life of the belts for driving the scrapers. Leather belts will not last long in high temperature; but this is of far less importance than the comfort of the man who must periodically stay in a stifling atmosphere long enough to oil the scraper mechanism and keep it in order.

It might be well to add a caution regarding the location of the belts. Avoid placing them so that they will hang at rest near a hot flue while the economizer is shut down, otherwise they will be quickly dried out or burned.

Leaving out all considerations of head room, light, and ventilation, the architect naturally wants to place the economizer just above the boilers, utilizing the back wall of the building as one side of the economizer housing. This plan may be economical in first cost for it minimizes the expense of flues, walls, etc.; but it usually shuts off all light from the space behind the boilers, for it is beneath the economizer, and often allows too little head room, either for repairs or ventilation.

The cost of an extra wall or even extensive alterations should not be weighed against light and ventilation for the surest way to reduce operating expenses is to give the attendant a chance to keep the reversing mechanism and scrapers in good condition.

As an example of a power house arrangement hav-

ing the economizer divided into 2 sections is shown the plan of the power plant of the R. I. Suburban Co., Providence, R. I. Here, Fig. 1, each of the 2 Green economizers with the boilers it serves forms a unit which may be operated independently of the other. The arrows show the path of gas so well that a more detailed explanation seems unnecessary.

In Fig. 2 are shown both plan and elevation of the power house of the Flint Mills of Fall River, Mass.

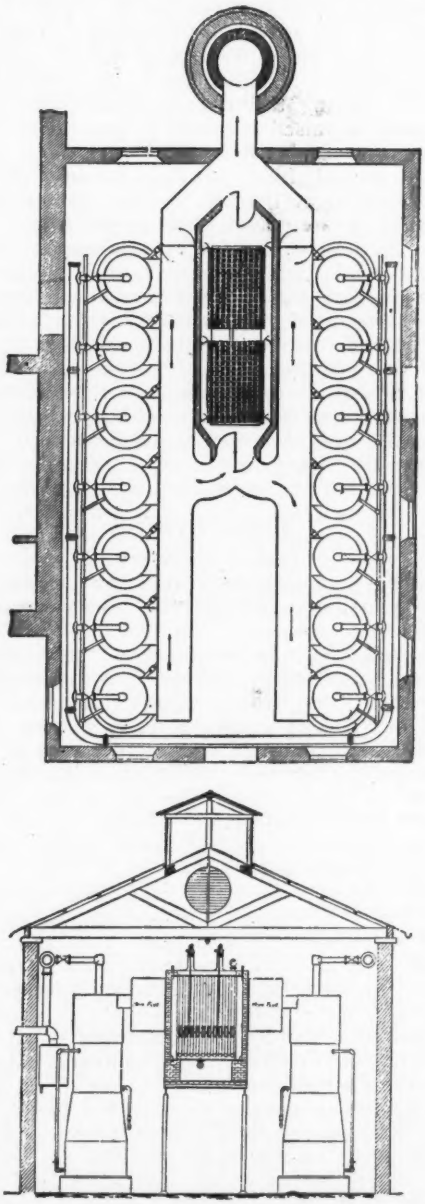


FIG. 2. ARRANGEMENT OF ECONOMIZERS SERVING VERTICAL BOILERS

The 14 vertical boilers discharge the waste gas into a Green fuel economizer so located between the boilers that there is room for the main flue between the boilers and the economizer. For 4 of the boilers the main flue and bypass are one and the same; that is, the boilers discharge into the flue whether or not the economizer is in operation. The economizer takes up no floor space for it is supported at a height that brings the lower part of the economizer nearly up to the top of the boilers.

A power plant built and operated for some time without an economizer and later equipped with this apparatus at great expense is shown in Fig. 3. In this plant there were 12 chimneys, 1 for each boiler. Relative location of railroad track, boiler house and engine house prevented erecting the economizer in any of the buildings. At great cost for alterations, the 2 economizers were supported upon heavy structural steel on the roof of the engine house.

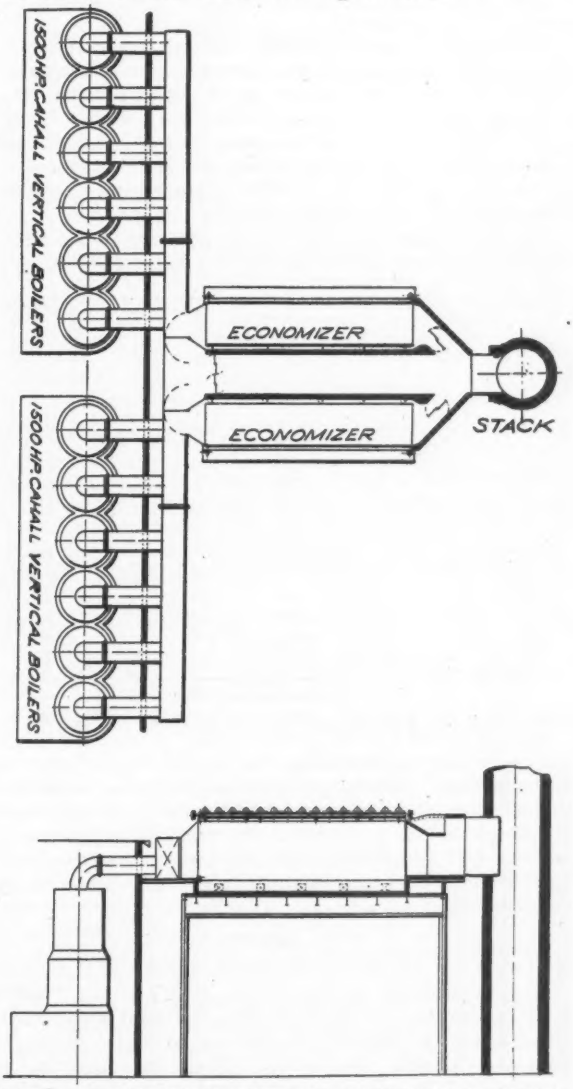


FIG. 3. PLANT REARRANGED TO ACCOMMODATE ECONOMIZERS

As the economizers could not well deliver the gas to 12 chimneys, the small individual stacks were taken down and 1 large concrete-steel chimney built. The 2 groups of 6 boilers each discharge into a flue which leads the waste gas to the 2 economizers from which it goes to the chimney as shown in Fig 3. An owner of a small plant might hesitate before spending so much money for change in design, but in this case the economizer has 1200 pipes and the boilers average about 2500 hp. Running 24 hr. a day the opportunity for saving is great; at 15 per cent the saving would be 375 hp.

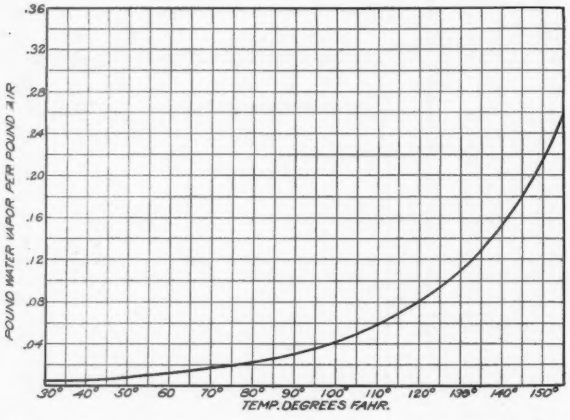
COOLING TOWER*

By M. R. Bump

COOLING towers are classified in 2 general classes, namely, forced-draft and natural-draft towers, the distinction being in the method of circulating the air in the towers. The relative merits of the 2 types involves climatic conditions, ground space, the cost per unit of surface as compared with the cost of fans plus their operation and the adaptability of tower to the condenser.

Temperature and humidity are of great importance in cooling tower design, and on this account each installation must be treated as a separate problem, and there can be no standard sizes for towers. Most of the heat extracted in a cooling tower goes off as latent heat of vaporization of water vapor to saturate the air leaving the tower. The balance goes directly to heat the air passing through the tower.

During winter months the proportion of the heat that goes to heat the air is much greater than in the



WATER FOR AIR SATURATION AT DIFFERENT TEMPERATURES

summer months and may exceed the latent heat of vaporization. Taking as an example an air temperature of 82 deg. F. and supposing the air to be saturated (raining) at that temperature, and that the air is heated to 92 deg. F. in the tower and leaves the tower saturated at that temperature, the heat extracted by each pound of air would be as follows:

Heat Absorbed

TO heat the air 10 deg. F. would require 2.375 B. t. u. The saturated air at 92 deg. will contain 0.03289 lb. of water vapor and at 82 deg. it contained 0.02361, the balance of 0.00928 lb. having been taken up in passing through the tower. The heat required to evaporate 1 lb. of water from and at 90 deg. is 1051 B. t. u., and the heat extracted in evaporating 0.00928 lb. of water would be approximately 9.75 B. t. u. Therefore, each pound of water leaving the tower at 92 deg. would carry away 2.375+9.75, or 12.125 B. t. u., and the work done by the evaporation would represent about 80 per cent of the total. If the air entering the cooling tower was not saturated, it would be able to pick up a still greater quantity of water and the heat in evaporating would be still greater.

In this connection it is interesting to note that where the air entering the tower is comparatively dry it is possible to cool the water below the temperature of the air, and this effect has been noted in several tests on a natural-draft tower in Denver.

Attention is called to the accompanying saturation curve for air at 29.92 in. barometric pressure. The very rapid rise in the amount of water vapor to saturate the air as the temperature increases indicates that it is desirable to heat the air leaving the tower as high as possible; hence, the temperature of the water leaving the condenser and entering the tower must be raised as nearly as possible to the temperature of the exhaust steam. One pound of saturated air heated from 90 deg. F. and discharged as saturated air at 100 deg. F. will extract nearly as much heat as one pound of air raised from 0 deg. to 40 deg. F. and saturated when leaving at that temperature.

For average conditions a tower can usually be figured safely upon a basis of maximum temperature of 90 deg. F. during a rainstorm when the air is saturated. On days when the temperature is in excess of 90 deg. F. the humidity will be considerably below saturation, as a rule, and the capacity of the tower will equal that for 90 deg. Basing estimates upon the air supply as stated, the problem becomes one of determining the amount of surface required.

Surface Required

THE amount of heat to be extracted from the water can be accurately estimated by the steam consumption of the engine and the quality of the steam entering the condenser.

Allowing that the water leaves the condenser at a certain temperature and enters at a certain lower temperature, the quantity of water required is determined. In making these figures it will be seen that the widest possible range in temperature of the water should be secured. Then in cooling this amount of water in the cooling tower the amount of surface required must be calculated. This is one of the most indefinite points in cooling tower design and is the most important one.

The rate of transfer of heat from water to air, either direct or through a diaphragm, varies through rather wide limits. The amount of water to saturate the air is greatly increased by rapid circulation of the air. On the other hand, if the air is forced through the tower too rapidly, it does not become fully saturated and, therefore, the quantity of air required is greatly increased. In the ordinary natural-draft tower the greatest care must be used to get full benefit of all the air passing through the tower, while in forced-draft towers there is always more or less water carried away mechanically and the air leaving the tower is seldom saturated, indicating that more air is being used than would be necessary in a properly designed tower.

In the cooling tower the heat is transferred directly from water to air and the amount of surface depends quite largely upon the rate of circulation of the air, and no definite figures were obtainable upon the transfer in forced-draft towers. By calculating this coefficient upon a natural-draft tower in Lincoln, Neb., a heat transfer of 6 to 8 B. t. u. per square foot per degree per hour was shown upon a series of tests. Using 7 B. t. u. as a basis it is seen that the sur-

*Abstract of a paper read before the National Electric Light Association.

face required to produce very high vacua during hot weather would be enormous. Taking the temperature of steam at 28-in. vacuum at 102 deg. F. and allowing 5 deg. differential between steam and discharge water, would make the temperature of the water entering the tower 97 deg. If the air were up to 90 deg. in temperature, this would allow a maximum working range of only 7 deg. and the surface required would be 22 sq. ft. per pound of steam condensed per hour. For a differential of 10 deg. the surface required would be 15 sq. ft., for 20 deg. 7.5 sq. ft., and for 30 deg. 5 sq. ft. per pound of steam condensed per hour. In each of these cases the vacuum would be reduced and at the 30 deg. differential it would be 26 in.

Tower Filling

VARIOUS materials have been used for wetted surface in cooling towers. Rough boards have been successfully used, but they take up a great deal of room, and the cost per square foot of surface is high when compared with other materials. Wood blocks, tile, and the like, have been used largely in forced-draft towers, and the results are satisfactory except as to first cost. The use of curtains made of galvanized-wire screens has been tried, but the first cost is high and the screens are not entirely satisfactory in distributing the water. A number of tests have been made with burlap curtains, and the results thus far have been above expectations. The burlap is very cheap and is easily made into curtains. These curtains are comparatively light and easily suspended in the towers. The only difficulty has been to secure a long-thread burlap so that a portion of the threads will not wash out and enter the piping system. Some of these curtains are now 4 yr. old, and the expense for renewal will be nominal. Several suggestions have been made as to tarring or painting the curtains as a preservative, but the cost and value of these treatments are doubtful.

Forced Draft

IN the design of forced-draft towers, the following conditions must be considered: 1. The tower should be laid out with great care to secure proper distribution of the air and water. 2. The fan capacity should be figured upon a basis of handling saturated air, and the path of the air should be such as to bring the water and air in intimate contact so that the air will leave the tower as nearly saturated as possible. 3. Care must be taken to prevent loss of water by being carried away mechanically with the air leaving the tower. 4. The tower should be as low as possible and the water pumped no higher than absolutely necessary. 5. In laying out the water distributing system, care must be used to reduce the friction head to a minimum.

It is the author's opinion that much more uniform and satisfactory results can be obtained by placing the fan at the top of the tower and drawing the air through the tower. On account of the moisture present it would be necessary to protect the fan blades from rust by galvanizing or frequent painting.

Natural Draft

NATURAL-DRAFT towers should be set in as open location as possible so that full advantage can be taken of winds to aid the draft created in the towers. Where set in open spaces it is advisable to have the sides, or at least a portion of each side, equipped with removable doors so that the air openings can be changed to suit the direction of the wind.

In the tower the greatest freedom of air movement is necessary, and the design of the water distributing system must be made with a view of leaving as much free air space as possible. In spacing the curtains in the tower, it is necessary to place them close enough together to get the full benefit of all the air passing; but, as pointed out, the distributing troughs must be laid out to allow as free air travel as possible. If the amount of water flowing down the curtains is too great it will create a counter-effect to the draft and will retard circulation of air in the tower.

Make up Water

AN important feature of the tower is to house the air openings properly, to prevent loss of water during high wind-storms. If no loss of water occurs, the amount of condensation from the steam, if the jet condenser is used, will be more than sufficient to supply the water evaporated in the tower. If a surface condenser is used, the make-up water required in the tower should not exceed and will ordinarily be somewhat less than the amount of water supplied to the boilers. Where a jet condenser is used, the cold-water supply to the boilers can be passed into the tower pit and condenser inlet and the water for boiler supply drawn from the hot water leaving the condenser.

Water Distribution

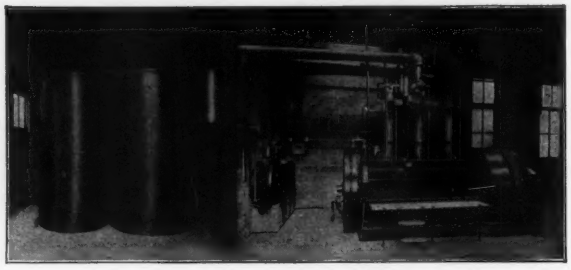
IN the design of the water distribution system, the friction head must be kept down as much as possible when proper distribution of the water is maintained. It is very essential that the water be distributed evenly over all of the curtains or wetted surface, and this as a rule necessitates some experimenting on the tower in order to reach all the curtain with an equal supply of water. An effective means of accomplishing the result is to distribute the water from 2 or more troughs. The water discharged from the pipe at 2 or more points in each trough will maintain practically uniform level in the troughs.

Discharge from the main troughs should be through vertical slotted openings in the sides, so that the quantity discharged to each curtain will vary as the head of water in the troughs without creating any friction head. The individual troughs supplying each curtain should be made as narrow as possible in order to leave ample space between troughs for air openings. These troughs should discharge through slotted openings, similar to the main troughs, against a metal strip or vane, which acts as the hanger for the curtains and on which the water is uniformly distributed across the full width of the curtain.

Some very intersting experiments have been made on a combination of condenser and cooling tower in which the steam discharged from the engine enters coils of pipe or chambers over which water is sprayed and air rapidly circulated. This plan has shown promising results. The amount of water required in the condenser is practically the same as the amount condensed.

DIAMOND STATE FIBRE CO., Bridgeport, Pa., is building a new storehouse from plans prepared by F. W. Dean, Boston. It is 268 by 130 ft., 3 stories, of standard slow-burning mill construction. Mr. Dean is also preparing plans for a new boiler plant of 2400 hp., which will be equipped with mechanical stokers, induced draft, pumps, feed-water heater, etc., and an overhead coal bunker with 1000 tons capacity. Work will be started on this as soon as the plans and specifications are completed.

Gas Producers



And Engines

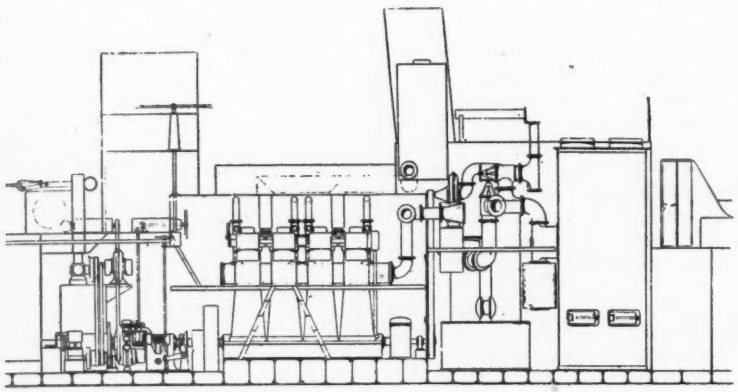
MARINE SUCTION PRODUCER ENGINES

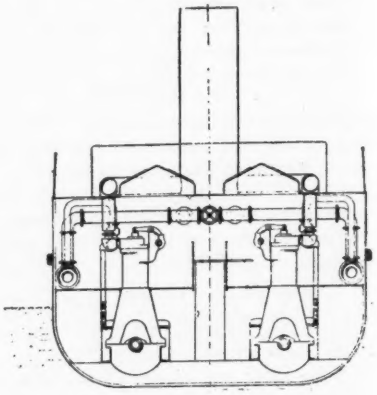
SUCCESSFUL OPERATION ON RIVER RHINE

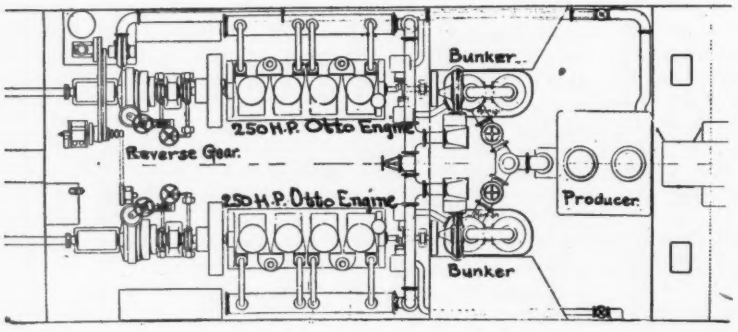
NEARLY 10 yr. ago a number of canal boats equipped with suction producers and gas engines as large as 45 actual horse power were sold by the German factory of the Otto Gas Engine Works. On account of the considerable space occupied by the producer plants as then built, the business grew very slowly. Gasoline and kerosene engines almost monopolized the field. The successful operation of the marine producer gas engines on canal boats, however, indicates that there are possibilities in the use of such plants on larger tow boats, or tugs.

With the further development of producers, it became possible in those of the double-fire type, to utilize brown coal briquettes as well as anthracite, and as these briquettes can be obtained cheaply anywhere on the Rhine, the economical operation of larger boats with producer equipment became possible.

After making a careful estimate of the cost and conditions of operation, it was found that the brown coal producer plant had a commercial superiority over steam, and the company decided to construct such a boat.







PRODUCER GAS PLANT IN RIVER TUG

Accordingly the tug Deutz was equipped with a 500 i. hp. gas engine plant in place of a 300 i.hp. steam plant. This required a lengthening of about 10 ft. Its present measurements with 30 tons of briquettes on board, are: Over all length, 112 ft.; greatest width, 20 ft.; depth at bow, 5½ ft.; depth at stern, 6 ft. The stack was retained to provide free outlet for the exhaust.

The whole machinery layout, shown in the illustration, occupies a space 20 by 42 ft. The producer room is separated from engine room by a partition provided with a sliding door. The height of the producer room is 14½ ft. This room contains producer, gas cleaning apparatus, and the coal bunkers. The producer is of the double-fire type, in which all the volatile matter in the fuel must pass through the upper fire zone before it reaches the gas outlet. This makes the gas practically tar free.

The cleaning apparatus consists of 2 separate units, capable of independent operation. After passing through a small scrubber with a spray at the top, the gas enters the main scrubber, which is provided with 8 spray heads, one above the other, and each removable while running. From the main scrubber the gas passes to a centrifugal washer, driven from the main shaft, and provided with suitable water sprays. The gas next goes through a water separator. The 2 scrubber units have a single pipe leading thence to the gas receiver and then to the engine.

There are 2 4-cylinder 250-hp. engines, each driving a 5-ft. propeller through a reverse gear. The engine speed can be controlled between the limits of 90 to 200 r.p.m. from the engine platform. While maneuvering and taking up tows, one engineer and helper operate the machinery. The helper relieves the engineer during part of the long 16 to 18-hr. day. The gas engine and reverse gear are well adapted to the difficult service in maneuvering, making the operation quick and certain.

In the free part of the engine room are 2 pumps, one for delivering cooling water and scrubber water, and another for pumping waste water from a pump under the scrubber.

On the aft port side of the engine room, a 7-hp. auxiliary gasoline engine is placed. This engine drives the compressor of the air equipment, and exhauster for fanning the fire in the producer. By the use of a special belt it can be pressed into the service of raising the anchor, and also for pumping out. In regular operation this is done by the drainage pumps which are provided with special suction piping for this purpose.

After the regular layover of 6 to 8 hr. the plant can be put in operation in a quarter hour with absolute certainty. The construction of each cylinder as a separate unit has much to do with this success.

The following table gives the weight of the machinery parts in pounds per indicated horse power:

Engine, fly wheel, and reverse gear	158.00
Producer, lining, scrubber, and water in apparatus	189.00
Pumps, auxiliary engine, and other parts	15.50
Piping	13.25
Fuel in producer	13.25
Total lb. per i. hp.	389.00

The weight of the producer plant could now be made considerably less than this. The weight of a triple expansion steam engine of the same indicated horsepower would be:

Engine	198
Boiler	176
Auxiliaries and piping	60
Water in boiler	62
Total lb. per i. hp.	496

which is a fair average weight.

It therefore appears that the marine producer gas engine plant is 20 per cent lighter than a steam plant of the same indicated horsepower. Further, the steam plant requires considerably more room. The cost of the gas-engine plant is about 10 per cent greater than that of the steam plant.

The suction gas tug Deutz had by September 20, 1909, or about 3 months after its first start, already made 12 round trips, or 1200 hr. of towing. This speaks well for the reliability of its operation. The tug can average 3½ miles per hour against the swift river current with 2 loaded tow boats with a total paying cargo of 3200 tons.

The tug with its tow makes a round trip in a little over 100 hr. Including coal used by auxiliaries and coal used during layovers it averages 550 lb. of lignite briquettes an hour. This average is for 719 hr. run, and includes all coal burned in the boat during this time.

At a cost of $2.16 a long ton for the briquettes the fuel cost for the return trip is $100\times550\times2.16\div2240=\$55$. A barrel of lubricating oil containing 50 gal. is used each round trip.

The crew for 16 to 18-hr. days consists of captain, helmsman, machinist, helper, 1 or 2 laborers, and a sailor, or 6 to 7 people in all.

The attention to the producer consists principally in coaling, which is done by raising fuel by the bucket, using a winch, which is arranged to make it easy to drop the fuel directly into the producer. There are 2 such lifts, one each for the port and starboard bunker. The fire is coaled every half hour, using one bucket from each side. Every 2 hr. the grate is shaken a few times, and every hr. the fire is clinkered. This work is done without dirt or dust.

The gas plant has an advantage of being absolutely smokeless, and to permit forced driving which has grown to be a custom, the rated power must be fixed with this consideration in view.

The gas power tug surpassed the expectation of the builders in every respect, and while no doubt considerable work is still required to perfect the design of the power plant to the various kinds of marine service, the foundation of success has been assuredly laid.

MAKING ENGINEERS FOR GAS ENGINES

By Harry H. Yates

DO gas engines need engineers? Yes, of the kind who rightly manage engines. In my earlier experience, not many years ago either, I confess I used a wrench too much, not that I condemn watchfulness and attention to little things, but there is a place to stop, and in that line experience is the only teacher, and severe too, for I know I have been "kept in" more than once by her. I feel that I am out of the primary class, however, but not yet in the high school, although I have the same teacher she is not quite so hard with me.

One point in particular that I want to bring out is this: A reputable manufacturer of gas or other engines presumably knows more about his product than anybody else, so when taking hold of any new machinery I endeavor to learn as much about it as possible, as soon as possible, and leave it alone as far as making any adjustment, unless something becomes loose, until I understand it thoroughly. I consider it good practice to prick punch all places where slippage is possible so that any derangement of parts will be more easily noted, also, in case of parts wearing and apparently needing adjustment, it is possible to return to the original position should change not be beneficial.

In most cases it would be better for wrenches to be placed behind glass which would have to be broken to get them, like fire-alarm-box keys, and a good excuse would then be necessary.

The source of knowledge is immaterial so long as it is reliable; I consider visiting various plants and using one's eyes as well as ears a reliable way. Much

can be learned without asking many questions. With one exception, I have always found men willing to aid one in obtaining the information desired.

I also consider it the engineer's own fault if he does not prepare in advance for possible changes, with the facilities at hand for learning, such as Practical Engineer and other papers as well as the libraries in most cities, to say nothing of correspondence schools, there is no excuse for the man that wants to learn and does not. Some men consider a dollar very large when asked to subscribe for a practical paper, but think nothing of taking the Sunday magazines and comic supplements which cost several times that much in the course of a year.

I am reminded of a man, a running engineer whom I tried to interest in buying an indicator. "What do I want with one? Only chiefs have use for such things." I wonder if he will ever be a chief.

Another thing I want to mention concerning steam engineers changing over to gas; most of us who study and have reached the point where we are able to change, have also reached a position where a fair salary is paid; now when we change over to gas we dislike to drop any salary as well as accept a subordinate position, even temporarily, and want to secure a position at least equal to our old one, so we turn places down where we might soon get back our usual rate as soon as we "make good."

No matter how much we study, we need practical experience and the only way to get it is to "get it." It may be possible for us to spend an occasional hour with a friend who operates a gas engine, or even an application at the office will usually secure the desired permission. I have never been refused, have even had the superintendent personally show me around. But what we actually need is to grab hold of the throttle and know that it is "up to us" to make it go, and I have found from personal experience that if one wants to do a thing it is usually done. What is really needed is want-to-do-it-iveness. I believe that with the at-home feeling around machinery and knowledge of the fundamental principles of steam engines, as well as familiarity with the indicator, any steam engineer has every advantage to make a successful gas engineer. The knowledge of the operation of the different cycles and methods of governing should not be difficult to acquire, nor the means of operating the valves and ignition system and its faults. The main difference, as I see it, is in the higher temperatures and pressures and their attendant lubrication difficulties. Every effect has its cause and we need the experience to enable us to reason out one from the other, and any engineer worthy the name should have the ability and desire to acquire the experience.

Yes, gas engines need engineers.

LARGE GAS ENGINES*

By J. D. Lyon

EVOLUTION of the large gas engine has shown a remarkable convergence of design among the several builders toward a general type, which may be safely taken as representative of American practice.

This type is the tandem double-acting four-stroke cycle with side crank and supported water-cooled pistons and rods.

The very general adoption of this type would seem to mark it as a true product of evolution—a "survival of the fittest."

In Europe the same type predominates, but the usual construction is with center instead of side crank.

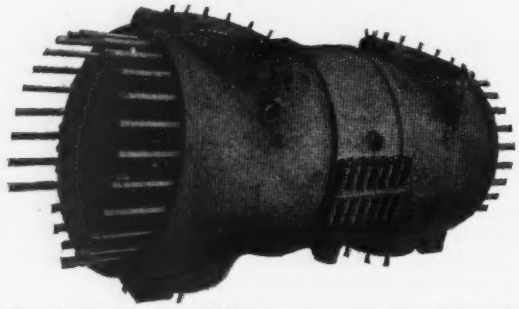


FIG. 1. LARGE GAS ENGINE CYLINDER, SHOWING THE BOLTS NEEDED TO CARRY THE HEAVY PRESSURES

For the purpose of the present paper any engine having the foregoing characteristics of design will be treated as a large gas engine, although the horsepower rating may in cases hardly seem to justify the designation.

At the present time it is difficult to predict accurately either the minimum or maximum sizes in which the type just described will be built, the two limits being fixed by different reasons. The smaller sizes of double-acting engines meet in competition the simpler single-acting types under conditions growing more favorable to the latter as the size decreases, so it would seem that two to three hundred horsepower capacity in a single-crank tandem double-acting engine would approximate its commercially desirable minimum.

As to maximum capacity to be obtained in a single cylinder, it must be borne in mind that the quantity of heat to be carried away by the cooling water increases much more rapidly than the cooling surface, with increase of cylinder diameter, so that lubrication troubles and combustion difficulties due to higher cylinder temperatures and the effect of necessarily lowered compression upon economy will probably serve to fix the limit of size.

Another good reason why the present large engine may not be greatly exceeded in capacity is that there is no appreciable gain in economy or material decrease in cost per horsepower to be obtained by increased size. The weights per brake horsepower as given by one prominent manufacturer show a very regular increase from 242 lb. for an engine of 400 b. hp. to 372 lb. for one of 2000 b. hp., all being of the single-crank double-acting tandem type. These figures show the disproportionate increase in material to capacity.

A double-crank engine of say 4000 b. hp., using natural gas, would weigh exclusive of flywheel, approximately a million and one-quarter pounds. The crank shaft would be 30 in. in diameter, with crank pin 18 to 20 in. in diameter. For alternating current service the flywheel would weigh at least 250,000 lb.

For gas of low heating value the cylinder diameter would, of course, be increased.

These dimensions are approximately those of the 33 engines in service at the Indiana Steel Co. plant at Gary, Ind., and those at the Edgar Thompson plant at Bessemer, Pa.

*Read before the National Gas and Gasoline Engine Trades Association.

The latter plant was put into operation with 2 2700 hp, gas-blowing engines in December, 1906, a 2000-kw. gas-driven generating set following in November, 1907.

The operating record in this plant has been excellent, the engines being in service month after month from 96 to 100 per cent of the possible running time, and this means in such a plant over 80 per cent of the total elapsed time.

The Gary (Ind.) plant has the distinction of being the largest gas engine installation in the world, the 33 engines aggregating practically 100,000 hp.

This large works depends upon gas engines exclusively for its regular operation, the steam equipment being small and held for emergency only.

These engines have in every respect fully justified the confidence of both the builders and the purchasers, as they have been working smoothly and practically continuously since their installation, beyond infrequent stops for adjustment of wearing parts.

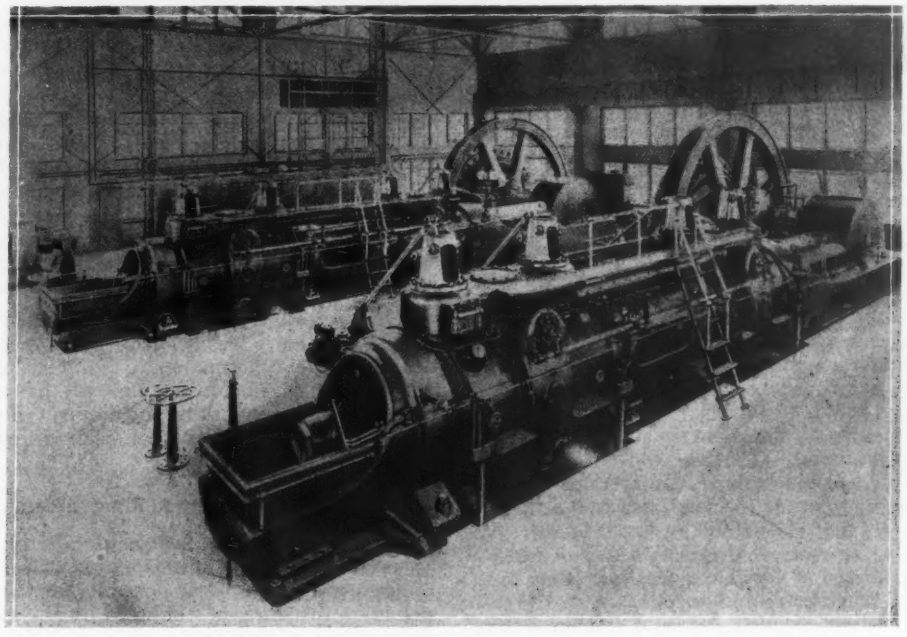


FIG. 2. 1000 HP. UNITS AT THE SOUTHWESTERN STATES PORTLAND CEMENT CO.

An interesting evidence of the soundness of the mechanical principle involved in the present practice of supporting the pistons on outside cross-heads, and carefully water-cooling both pistons and rods, is shown in this plant by the records of over one year's operation of the 8 Westinghouse engines.

No repairs whatever have been required by any of the 32 sets of piston rings, and examination of the power cylinders shows only highly polished surfaces.

One cylinder recently examined after 6000 hr. service, still showed original tool marks.

One engine had not been opened for inspection at the end of a year's operation, and was being continued in regular twenty-four-hour service.

As far as the future is concerned, the greatest general application of the gas engine in large capacities will be found in connection with the producer, and many examples of this type of installation are already to be found.

There are many deposits of fuel which have little value for use in a steam plant, but which are well adapted for use in producers. Lignite, peat and the culm or slack accumulations thus become valuable, when located near a market for power.

The cost of a complete gas power plant is greater than a steam plant, and while the economy of the latter in the matter of fuel is not so good as the former, there must be a fuel price at which the gain due to fuel saving would be more than balanced by the fixed charges on the additional investment.

The point of intersection of the over-all economy curves of the 2 plants will vary considerably by reason of local conditions, as for instance in a plant which requires a large amount for exhaust steam for heating, steam power would be desirable with higher fuel cost than in a case in which power is the only requirement.

The Richmond (Va.) plant of the American Locomotive Works is a good example of gas power plant, being an average case in the matter of fuel costs.

The equipment in this plant consists of 2 R. D. Wood & Co. bituminous producers, rated at 600 hp., 1 Westinghouse horizontal gas engine rated at 550 hp., direct connected to Westinghouse d.c. generator of 300 kw. rating.

Fuel used is Pocahontas run-of-mine of an average heat value of 14,000 B.t.u. as fired, and costing $2.40 to $2.60 per ton delivered.

The plant is operated 24 hr. a day 5.5 days a week.

An operating record of this plant from April 1, 1909, to January 1, 1910, is in our hands, and I believe a summary of this record will be interesting.

The load factor is high, averaging 70 per cent during the 9 months under observation, and during 1 month, December, was 110 per cent of the generator rating.

From April 1 to January 1 the average coal consumption was 1.94 lb. of coal per kilowatt-hour, including standby, the standby charge being 0.03 lb. a kilowatt-hour, or a standby loss of 1.5 per cent.

During December, when the load factor was very high the coal consumption averaged 1.68 lb. of coal per kilowatt-hour, including standby. The standby loss for this period was 0.7 per cent.

More interesting, perhaps, than fuel cost is the total cost of operation.

For the 9 months producer room costs averaged 0.689 c per kilowatt-hour. Engine room costs for the same period averaged 0.479 c. During the month of December, with its unusually favorable load conditions, these figures were 0.537 c and 0.376 c, respectively.

The total cost per killowatt-hour for the nine months is therefore only 1.168 c. and for December 0.913 c. These costs include everything legitimately chargeable to the plant.

The Allis-Chalmers Company has one of its pioneer installations, that of the Milwaukee-Northern Street Railway Co., at Port Washington, Wis. The units are each 1250 kw. capacity, and are operating on producer gas, and are reported to have been producing a kilowatt at the trolley upon less than 2 lb. of coal per hour, including all losses. I am not familiar with the operating conditions, but when one considers the low average load factor which usually prevails in railway work, this is a highly creditable performance. This plant was operated for 1 year with only 1 engine in service 22 hr. a day.

The Rockland Electric Co., Hillburn, N. Y., operate 3 350-hp. and 2 470-hp. Westinghouse gas engines driving alternating current generators in parallel.

An interesting evidence of the excellent regulating qualities of this type of engine is shown by the parallel operation of these engines for several hours with an entire cylinder out.

The general characteristics of this type of engine are shown by those in the plant of the Mohican Oil and Gas Co., at Howard, O. This plant consists of 2 Westinghouse twin tandem 23½ by 48-in. gas engines, connected to Ingersoll-Rand hurricane valve compressors. These engines have been subjected to very careful test, and their performance has been uniformly excellent. The compressors receive gas from wells at pressures varying from 25 to 80 lb. gage, and deliver into pipe lines at from 165 to 200 lb. gage. The engines are capable of compressing the gas 285 lb.

Normal pressure at the plant is about 185 lb. discharge and 50 lb. intake. The heat consumption shown in a test of these engines shows an average of about 8400 B.t.u. per i. hp.-hr. at full load, which is equivalent to somewhat less than 10,000 B.t.u. per b. hp.-hr. The normal brake horsepower of these engines is about 1250, and they are operated at variable speeds, according to the output desired, ranging from 88 to 44 r.p.m.

Each combustion chamber on these engines is fitted with 2 igniters, which is the usual practice in this type of engine, or 16 igniters for each engine. An idea of the reliability of the ignition system now employed in engines of this class may be obtained from a statement by the operating engineer, that at the time of an inspection of this plant, made by a delegation from the Natural Gas Association of America, he had not had an igniter out of either engine for over 6 weeks. Continuous runs of 10 days to 2 weeks are common in plants of this description, and less difficulty has been experienced in making such runs than would be expected if steam equipment were employed instead of gas.

The Iola Portland Cement Co., at Iola, Kan., has been operating 3 500-hp. natural gas engines since 1906, and 2 700-hp. engines which were installed in 1909. An example of operating record is shown by a report for the period, January to April, 1907. For all 3 of the engines the average hours' run per day was 23.17 or 95.6 per cent of the elapsed time. Of the period of shut-down, only 0.63 of 1 per cent was due to the engines. This company also operates 3 engines in its gas compressor station, 17 miles from the cement plant. The company recently furnished us with the information that it has made a run of 31 days without a shut-down for anything for all 3 engines.

WHY IT IS UNNECESSARY TO COMPOUND A GAS ENGINE

By Chas. A. Haeussler

WHILE the internal combustion engine may be considered by the average engineer as beyond his comprehension and the operation within the cylinder too vague and mysterious to understand easily, it is in reality as a heat motor much simpler than the steam engine and its efficiencies are considerably more easily obtained and its losses more readily accounted for.

Even many who have made the steam engine a study and have a fair knowledge of thermodynamics feel that the gas engine, as it deals with higher temperature, might still be a greater problem to solve, and without investigation make but little effort to comprehend its principles and laws.

One prominent writer on the subject of internal combustion engines—and he seems to have had a wide experience—admits that indicating a gas engine is accompanied with so little success that he has never tried to obtain a diagram of what was going on within the cylinder walls. Yet, while there has been such a prejudice against engines which are supposed to get their power from violent explosions therein, the internal combustion engine of today is much better understood than was the steam engine at its age, and its losses, defects and disadvantages are more easily accounted for and fully comprehended.

One reason why the thermal efficiencies of a gas engine are more easily deduced is because we are dealing with a permanent gas under all conditions, while, with a steam engine, we have, during the progress of our working medium, a liquid, a vapor and a gas and the laws of each differ as do their physical qualities.

Reasons for Compounding Steam Engines

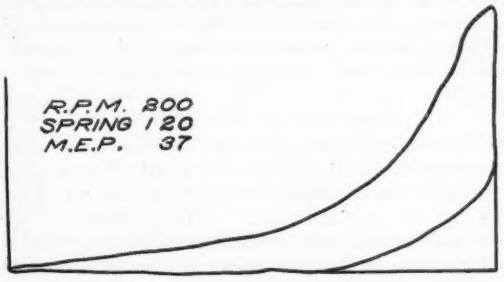
THE object of every heat engine is to get the difference between the initial temperatures and the final temperatures as great as possible, for the efficiency depends on the difference divided by the initial temperature.

Cylinder condensation is the greatest drawback to steam engine economy. The expansion in a steam engine does not follow the theoretical curve, because, as the temperature of the steam is lowered, it turns into water, cooling off the cylinder walls more rapidly than would a permanent gas, and that the next incoming charge is reduced in temperature and pressure by the cold walls. The colder the walls the more heat will be taken from the incoming steam, and to make this as small as possible and yet get the expansive force of the steam, more than one cylinder is used, so that the variations in temperature are minimized. If the steam were a permanent gas there would be no cylinder-condensation, and the second and third cylinder on the steam engine, so far as increasing the economy, would be as unnecessary as a large and small hole in the barn for a big and little dog. If there were no cylinder condensation, and there would not be if steam were a permanent gas, a single cylinder steam engine with the same initial pressure and the same number of expansions would give just as good thermal efficiency and a better mechanical efficiency than any compound, triple or quadruple expansion steam engine ever built.

Expansion of a Permanent Gas

WITH the internal combustion engine, we are dealing with a permanent gas, not taking into consideration the product of the combined hydrogen, which is a very small percentage, and we have no cylinder condensation with which to contend. The only object, then, of compounding a gas engine would be to reduce the terminal pressure and temperature and turn the heat into work instead of throwing it away in the exhaust.

In a paper read before the American Society of Mechanical Engineers on "An Efficiency Test of a 125 hp. Westinghouse Gas Engine" it was stated that 57 per cent of the heat units in the fuel supplied to the engine was accounted for in the exhaust, that the temperature of the exhaust gases after release was from 1048 to 1209 deg. F., and the pressure, as shown from the indicator diagram, from 40 to 50 lb. absolute.



GAS ENGINE CARD SHOWING ATMOSPHERIC PRESSURE AT RELEASE

To reduce this loss it is necessary to turn more heat into work and release it at a lower temperature and pressure.

With this high temperature and pressure when the exhaust valve opens, not only is there a low efficiency obtained, compared to what we should have with more complete expression, but we have to contend with a red-hot exhaust pipe and exhaust valve, a great strain on the valve opening mechanism, and a sealion "bark," which, without a muffler, can be heard blocks away. And again, the average temperature of the cylinder is so high that premature ignition is possible should the water circulation for any length of time be reduced. The only object of compounding is to obviate these troubles, a most worthy and necessary object indeed if they cannot be overcome in a simpler and easier manner.

Mr. Atkinson, with a single cylinder and with the same compression but a more complete expansion, obtained the first efficient gas engine at that time, yet the release was even then about 10 lb. above atmospheric pressure. From a thermal consideration, he was on the right track, but the engine, requiring a multiplicity of connecting rods, toggle joints and bell cranks, was a mechanical failure.

Compound engines have been tried and a lower terminal pressure and a higher efficiency have been obtained, yet the additional cost and complications have more than offset the advantages. The first Diesel motors were compounded, but the extra cost of construction, the loss of mechanical efficiency and the great increase in cooling surface for the released gases united to offset the possible gain, and the writer understands that the American type is now built only with a simple cylinder. In compounding a gas engine, even if it were the only way to increase the thermal efficiency by getting more complete expansion, many obstacles would have to be overcome, and the writer believes that on account of complications which would necessarily arise and from the fact that the same object may be obtained in a much better and simpler manner, compounding will never be a mechanical success.

We have shown that, as we are dealing with a practically permanent gas in the internal combustion motor, the only object of compounding is to increase the efficiency by getting a lower terminal pressure and herewith is submitted an indicator diagram for a single expansion gas engine designed by the writer, getting an impulse every stroke, in which the terminal pressure reaches the atmospheric line, yet the compression and initial pressures are the same as in the ordinary engine.

UTILIZING PRODUCER GAS FOR HEATING

APPLICATION of producer gas to power plants is of such widespread interest that the United States Geological Survey has devoted several years to the investigation of the values of various kinds of coal as gas producer fuels. The results of this work appear in Bulletin No. 416. In a series of 10 tests conducted at Norfolk, Va., the average amount of coal per brake horsepower per hour was 0.92 lb., and varied from 0.80 to 0.98.

These figures may very properly be compared with others published in the same bulletin. Mr. Stott, Superintendent of Motive Power, of the Interborough Rapid Transit Co., New York City, is therein quoted as saying that but 10.3 per cent of the energy in fuel is utilized as electrical energy in the Interborough power house.

He also presents in his paper before the American Institute of Electrical Engineers, 1906, a table showing the thermal efficiency of producer gas plants, concerning which he says: "The following heat balance is believed to represent the best results obtained in Europe and the United States in the formation and utilization of producer gas;" and in this table shows that 24 per cent of the energy of the coal is converted into electrical energy. Mr. Stott's figures seem to show that 24 per cent for the best producer gas plants should be compared with 10.3 per cent for large steam plants.

In the tests conducted at St. Louis by the Government on smaller apparatus and apparatus of the ordinary type, the amount of heat converted into electrical energy is much smaller, being only 4.86 per cent for steam power and 13.5 per cent, or nearly 3 times as much, for gas power. The evidence seems to be so overwhelmingly in favor of producer gas as a power plant fuel that the question naturally arises as to why it is not more generally used. The difficulty encountered in the elimination of tar from producer gas made from bituminous coal, has first of all been a serious handicap for a large part of the country.

Another difficulty is the heating of factories. Practically all factories are steam heated, a condition which results from or leads to the use of steam for power also. Doubtless large numbers of small industries would use gas producers were it not for the heating problem.

But this problem has recently been solved by the introduction of an "aertube heater" in which producer gas is used to advantage. In this apparatus manufactured by the Harrison Engineering Co., of New York City, the heat from the gas is transferred direct to the air which is forced through the tubes by means of a fan and is then distributed to the various parts of the building by means of ducts and flues. The direct transfer of heat eliminates all steam apparatus, and makes a licensed fireman unnecessary.

REFRIGERATING MACHINERY AND APPLIANCES*

By H. D. Pownall

ANYONE who has carefully noted the development of the refrigerating machine industry during recent years has undoubtedly felt astonishment at the progress made in this branch of engineering in so short a time. And particularly noteworthy is the large number of industries in which the refrigerating plant has rapidly found a use—not only found a use but proven indispensable. Until a few years ago the market for ice-making and refrigerating machinery was limited to those industries in which the use of cold was absolutely necessary to their existence.

During the past 5 yr., however, innumerable other trades have recognized the great advantages resulting from refrigeration and have introduced its use in hitherto untried fields. At the present time there are approximately 143 uses for refrigerating machinery. This widening range of industries in which refrigeration is utilized is largely due to the continuous advance toward perfection made in the construction of refrigerating machinery.

Increased production and superior quality, coupled with economy of manufacture, which can only be secured by completely controlling atmospheric conditions, have also been a powerful factor in spreading the use of refrigerating machinery.

Notwithstanding the numerous improvements made in the application of refrigeration, and the resultant increase in the use of refrigerating machinery, it may be safely asserted that this province of engineering is yet far from being exhausted. On the contrary, the increasing importance of refrigeration and of machinery for producing cold must assuredly become more fully recognized each year and the industry will expand and develop accordingly.

According to the "Ice and Refrigerating Blue Book" of 1909, a publication devoted to the classification and recording of refrigerating and ice making plants, there is a total of 16,160 refrigerating machines in the United States, (which, of course, includes those devoted to ice making), having a total capacity of 612,919 tons of refrigeration per day of 24 hr., or an average of 31.17 tons refrigerating capacity for each one of the 16,160 machines in use at this time.

The capital invested in the production of ice and refrigerating machinery is estimated at about $25,000,000.00. The capital represented in ice-making plants alone is considerably above $100,000,000. The wealth invested in industries dependent wholly or largely upon mechanical refrigeration in this country only is in excess of a billion dollars.

The value of mechanical refrigeration in such institutions as hospitals, sanitariums, morgues, and the saving of life and health by the more general distribution throughout the year of fresh, wholesome foods cannot be estimated in money value; neither can its worth in the iron and steel industries, in chemical industries nor in the added comfort to humanity be computed. Its incalculable influence in the improvement of manufacturing and social conditions is gradually lost from sight inasmuch as its benefits come gradually and are unconsciously accepted.

There is probably no other branch of engineering less thoroughly understood than that of refrigeration, this being partially due to the lack of printed matter or text books relating to this subject. And the lack of printed information is in a measure attributable to the fact that it is a very costly procedure to secure accurate data relative to this science. In electricity or other lines of engineering, a complete unit may be easily tested for both efficiency and characteristics at a moderate cost before shipment. An accurate test could not be made upon a refrigerating plant of any size, for less than $1000, and the data secured from this test in the majority of cases would be applicable to the one plant only.

Up to the present time, notwithstanding the wonderful strides which have been made, the various engineering bodies have failed to reach any definite conclusion as to what shall constitute a standard tonnage basis; that is, to establish a definite unit of refrigeration. The various manufacturers of such machinery therefore rate their product according to their own judgment.

Principles of Refrigeration

MECHANICAL refrigeration depends upon the fact that fluids in changing from a liquid to a gaseous state absorb heat, which, in turn, is given off on again resuming the liquid state. These different states are brought about by variation of pressure, due to the operation of a vapor pump or compressor, which compresses or elevates the pressure of the gas to a point which will permit of its liquification. The heat produced by compression is removed by water flowing over or through a condenser, it being necessary to remove one B.t.u. in the condenser for each B.t.u. absorbed by the gas in evaporating, plus a slight addition due to the heat caused by compression and by friction of the gas in the piping system.

The liquid flows from the condenser to a receiver and from the receiver through a controlling valve, erroneously called an expansion valve.

The pressure on the condensing side when using ammonia as a refrigerant varies from 125 to 200 lb., dependent upon the size of the condenser and upon the temperature and amount of water available for condensing purposes. The liquid, during refrigeration, first flows as a liquid through the controlling valve, where its pressure is reduced from the condensing pressure of approximately 175 lb. to that of the refrigerator, or about 15 lb. The temperature of the liquid flowing to the controlling valve is about 90 deg. F., and after expansion is about zero deg. F. This reduction in the temperature of the liquid ammonia is caused by the evaporation of a portion of the liquid, which, owing to its latent heat, cools the balance of the liquid to the refrigerator temperature of zero deg.

Theoretically, under the above condition about 18 per cent of the liquid is converted into gas at this point in cooling the remaining volume to the temperature of the balance of the liquid in the refrigerator, the variation in the 2 pressures being controlled by the rate of flow through the liquid valve and by the removal of the resultant gas with the compressor.

The refrigerating fluid is contained in coils or piping or in cylindrical vessels, similar to return tubular boilers. In an ice making system these coils or cylindrical vessels are immersed in a brine solution, this brine being caused to circulate rapidly around or through the piping system. The brine, being warmer than the ammonia, causes the latter to boil or evaporate.

*Abstract of a paper read before the Ohio Society of Mechanical, Electrical and Steam Engineers.

Ammonia boils at 29 deg. F. below zero at atmospheric pressure. During this process, the refrigerating agent absorbs from the brine a certain amount of heat which is conveyed to the compressor, the resultant gas being again elevated in pressure to a point sufficiently high to permit reliquification; thus a continuous cycle is formed, consisting of 3 functions, performed by the following parts of the equipment: 1, the compressor; 2, the condenser; 3, the evaporator.

It will be noted that the refrigerating fluid continually repasses through all portions of the apparatus, which is, as far as practicable, hermetically sealed, the refrigerating medium being alternately evaporated and condensed. It takes up heat from the material to be chilled and transmits it to the water circulated over or through the condensing coils.

Refrigerating Agents

MANY different volatile fluids are adaptable as refrigerating agents, but those which have proven most practical are anhydrous ammonia and carbonic anhydride. Although the same principle underlies the use of all such fluids, their physical properties vary and consequently demand different treatment to produce best results. In so far as the user is concerned, these differences result in the varying volume of fluid to be circulated and in the variation of the condenser and refrigerator pressures peculiar to each individual agent.

These conditions, in turn, determine the dimensions and strength of apparatus used. The chemical action of the various agents demands the use of somewhat different materials in the construction of the various parts of the equipment with which the fluid comes in contact. At the present time, ammonia leads the list in popularity, and in fact, has almost superseded all other refrigerating agents.

The ordinary working pressures of the ammonia compression or absorption system are from 15 lb. on evaporating side to 220 lb. on the condensing side, while that of carbonic anhydride is about 300 lb. on the evaporating and from 950 to 1250 lb. on the condensing side. It may be safely asserted, however, that in the United States there are now 199 ammonia compression plants sold to each carbonic anhydride system, therefore in the remaining portion of this paper, I shall confine my remarks to the machinery and appliances for ammonia compression machines only.

The Refrigerating Machine

OWING to the peculiarity of the ice-making and refrigerating business it is essential that nothing but highest grade material and workmanship be used in the construction of such plants. This is due to the fact that it is necessary that a refrigerating plant operate continuously 24 hr. a day for periods of 4, 5 or 6 months without interruption. Interruptions in most manufacturing establishments, caused by defective machinery or through carelessness do not usually result in such serious consequences as interruptions in a refrigerating and ice-making plant. In most manufacturing plants a few hours operation overtime will compensate for decreased production resulting from such delays, and it is possible through "the excuse department" to satisfy the customer for non-delivery of material.

Such excuses, however, are of no avail in an ice-making plant. If your ice-box is empty, you rely upon your iceman to replenish it; and if he is unable to do so, you are compelled to look for his competitor. The ice which he may bring tomorrow will be of no benefit to you today, consequently it behooves the intending purchaser of ice machinery to examine carefully and to purchase none but the best.

Indicator Cards

I SHALL show by the aid of diagrams the unreliability of indicator cards taken from an ammonia compressor.

Figure 1 shows a card from an 18 by 36 in. machine, operated at 60 r.p.m. pumping wet or saturated gas.

Figure 2 shows a card from the same machine under the same pressure, operating at the same speed, pumping dry gas. In card 1 it will be noted that the re-expansion loss is considerable, while in card 2 the re-expansion loss is practically eliminated.

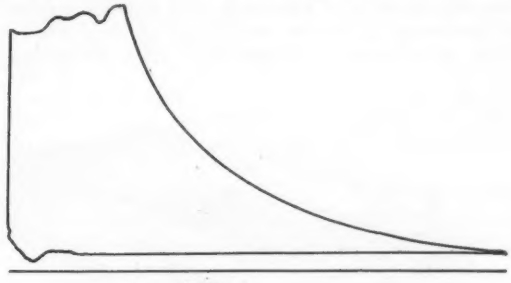


FIG. 1

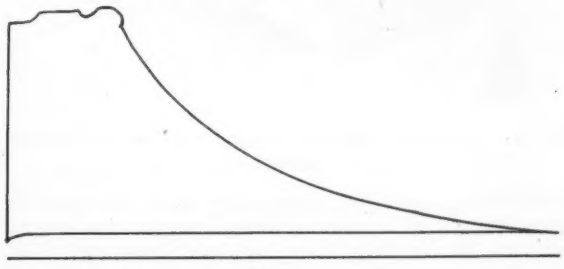


FIG. 2

FIG. 1. CARD FROM AMMONIA COMPRESSOR DELIVERING WET GAS

FIG. 2. CARD FROM COMPRESSOR PUMPING DRY GAS

This is accounted for by the fact that the re-expansion loss shown on card is due to saturated gas in the clearance space at the end of the stroke. I have frequently secured indicator cards from a machine pumping a wet gas, showing a re-expansion of at least 12 to 15 per cent, whereas this same machine pumping dry gas would not show over 2 per cent. From these facts it will be seen that indicator diagrams from ammonia compressors are of no value unless all operating conditions are known. Up to the present time no device has been perfected to indicate the percentage of moisture in the return gas to a refrigerating machine. It has also been demonstrated that pressure gages are unreliable, making it necessary to equip both the suction and discharge with mercury columns to secure accurate data. It is further necessary to know the exact temperature of the suction and discharge gas before any computations can be made.

Ammonia Fittings

THE importance of having mechanically perfect fittings, that is, valves, piping, connections, etc., in an ice-making or refrigerating plant cannot be too strongly emphasized. Perfect fittings result in a minimum loss of amonia and insure safety to those who handle the plant. With improperly designed fittings, or those constructed of cast iron or semi-steel, there

is generally a loss of ammonia and this loss is not merely initial but continuous from day to day, often increasing with the life of the plant. Each day means practically so much money wasted.

This loss is frequently attributed to decomposition of ammonia in doing its work, but such is not the case. The critical temperature of ammonia is 268 deg. The temperature of dissociation about 900 deg. F., while the average discharge temperature from the ammonia compressor ranges from 150 to 250 deg. F. Under these conditions practically no deterioration or decomposition will occur, the loss being due to leaky fittings, defective pipe joints or leaks around the stuffing box.

With perfect fittings and joints and a carefully planned circuit, the ammonia will not decompose and the perpetual and ever increasing expense for replenishing is avoided. As an illustration of economical

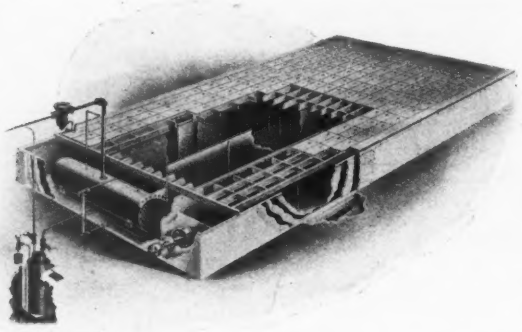


FIG. 3. TRIUMPH-POWNALL SHELL TYPE BRINE COOLING SYSTEM

installations, equipped throughout with cast-steel fittings and sweat soldered joints, I might refer to the Grocers' & Butchers' Ice Co., of Columbus, Ohio, which produces 120 tons of ice per day and operates with a loss of not more than 600 lb. of ammonia a year. Also the Hudepohl Brewing Co., of Cincinnati, in whose plant is installed about 60,000 ft. of 2-in. pipe; here the loss has been less than 300 lb. of ammonia a year. Similar plants using cast-iron or semi-steel fittings often require from 25 to 30 100-lb. cylinders of ammonia a year.

Steam Fittings on Ammonia Lines

I CONSIDER it almost criminal to allow the use of ammonia fittings such as are found on some installations; not only is there constant financial loss, but also actual danger, due to ammonia fumes. I recall one plant in Cincinnati in which ordinary steam fittings were used; that is, tees and ells of the malleable type and designed by the manufacturer for 125 lb. pressure. In this plant the erecting engineer succeeded in making joints which held until the plant was paid for. Since then, however, one of the 3-in. ells on the discharge line burst, causing a loss of the entire charge of ammonia and a shut down of 24 hr. duration.

In the case of a leak in a steam or water line, it is only necessary to shut off the valve controlling that portion of the piping system in order to empty the line to replace the defective joint or fitting, while in the refrigerating plant, owing to the cost of ammonia it is necessary that the ammonia be evacuated and stored in some other portion of the plant before it is possible to make the repair. This often requires several hours, and even after the ammonia has been removed, should the valves controlling the defective part of the piping system leak in even the slightest degree, it is difficult to make the repair. The importance, therefore, of using nothing but the best of material is selfevident.

I believe that all fittings used for ammonia work should be of a ductile metal and of such strength as positively to eliminate the chance of breakage. If through settling of the building, the pipe should become strained, the fitting should be of such strength as to allow the pipe to bend without affecting the fitting. When flanged type fittings are used, they should be of such construction as to permit the bolts to be drawn up to the point of destruction before distorting the fitting.

Materials and Construction

ALL fittings should be deeply recessed so that, when the pipe joint is made, the recess may be filled with solder, completely covering the exposed threads. If this course is strictly adhered to, the life of the piping system will be almost doubled, as it will be readily appreciated that on ammonia condensers and direct expansion coils exposed to moisture and then allowed to dry, a corrosive action is inevitable, and will eat through the pipe next to the fitting while the balance of the system remains intact.

If the pipe joint is of the recessed type, and the exposed threads are thoroughly covered with solder, such deterioration cannot occur.

All piping used for ammonia work should be of genuine wrought iron and each joint should be tested to 300 lb. air pressure under water before shipment. After erection the same test should be applied again. After the system is tight under such pressure, a vacuum of 29 in. should be placed on the entire system and allowed to stand for 24 hr. to ascertain the tightness under vacuum. Owing to the difficulty of breaking into the ammonia system, all valves should be of the double seated type to permit repacking the valve stems while under pressure.

Brine Cooling System

FIGURE 3 shows a view of the Triumph-Pownall shell-type brine cooling system for ice-making plants. With this apparatus, the ammonia is carried in a liquid form in the shell in precisely the same manner as water in a return tubular boiler. The brine is circulated through the tubes of the cooler, causing the ammonia to evaporate, the resultant gas passing off through the suction pipe at the top of shell. Between the shell and the compressor is placed a separator for the purpose of removing any unevaporated ammonia from the gas. Any ammonia so trapped is conveyed back to the shell in exactly the same manner as condensation from a steam separator is returned to a boiler. The ammonia level is indicated in a gage column located outside of tank.

By the use of this system all pipe and pipe joints are removed from the space occupied by the ice cans. Another advantage, low brine temperatures may be carried without danger of flooding the compressor with unevaporated liquid. The ease of control should be apparent as only one controlling valve is required and the ammonia is constantly in view in the column just as a water column which indicates the height of water on a boiler. With the old style system it is necessary to use valves on the inlet and outlet of each coil to regulate properly or control the ammonia, and the ice cans when dropped into the tank, frequently strike the coil, breaking a fitting or creating a leak in the joints. With the system here described such accidents are an impossibility.

VALVE DIAGRAMS

EARLY CUTOFF WITH THE D VALVE

IN discussing the action of the D valve it has been evident that cutoff and lead cannot both be made the same on account of the effect of connecting rod angle; but as some difference in lead is not of importance, the cutoff is usually made nearly equal by putting different laps on the 2 ends of the valve.

It is found that with equal laps, the cutoff will be earlier for the head end than for the crank end, hence the lap on the crank end of the valve must be reduced.

From the arrangement of the lap circle, if the lap be increased to get early cutoff its center must go higher, lead remaining constant, and the angle of advance must be increased as it is represented by the angle between the center line and the line through the center of the lap circle. The effect on exhaust will be to bring it very early, and if exhause lap be added to make release later, that will bring exhaust closure early with the result of too much compression. The effect of this variation is different for the 2 ends of cylinder, making the inequality of cutoff greater or calling for greater difference in steam lap to equalize it.

Problem in Early Cutoff

BOTH these effects are shown in the following problem: For an engine having a 10-in. stroke and with connecting rod 15 in. long, the lead is to be 1-16 in., maximum steam port opening ⅜ in., cutoff at ¼ stroke, and release at 95 per cent of stroke. The values to be found are, steam and exhaust lap for each end of the cylinder, valve travel, angle of advance, and compression. To avoid confusion in the diagram crank positions are found and referred to crosshead positions on a separate diagram, Fig 1, the scale being ¼ actual size.

Cutoff for the head end is at crosshead position C and crank position C and for crank end is at C′ and C′ respectively; release, head end is at r and R, and for crank end at r′ and R′. All these crank positions are of interest in the valve diagram only as to angular relation, hence they are transferred by the use of dividers to the crank circle on the valve diagrams, Figs. 2 and 3.

Head End Diagram

ON Fig. 1, for the head end of the cylinder the cutoff is at C and release at R; for the crank end cutoff to be equalized would be at C′ and release at R′. Taking up first the head end in Fig. 2, positions C and R are located from Fig. 1 by measuring up with compasses from the dead points, and crank lines OC and OR drawn. As lead is to be 1-16 in. it is laid off above center line and establishes crank line A^1 OA for admission. With OP=⅜ in. as radius an arc is drawn to establish maximum port opening, and line OQ is located midway between OC and OA^1 by drawing intersecting arcs from C and A^1 as centers.

Then, by trial, find a circle with center on OQ which will be tangent to OC, OA and OP and its radius is the steam lap for the head end of the valve, and the distance OQ to the center of this circle is the eccentricity.

This gives as steam lap 3 in., and for eccentricity 3 13-32 in.

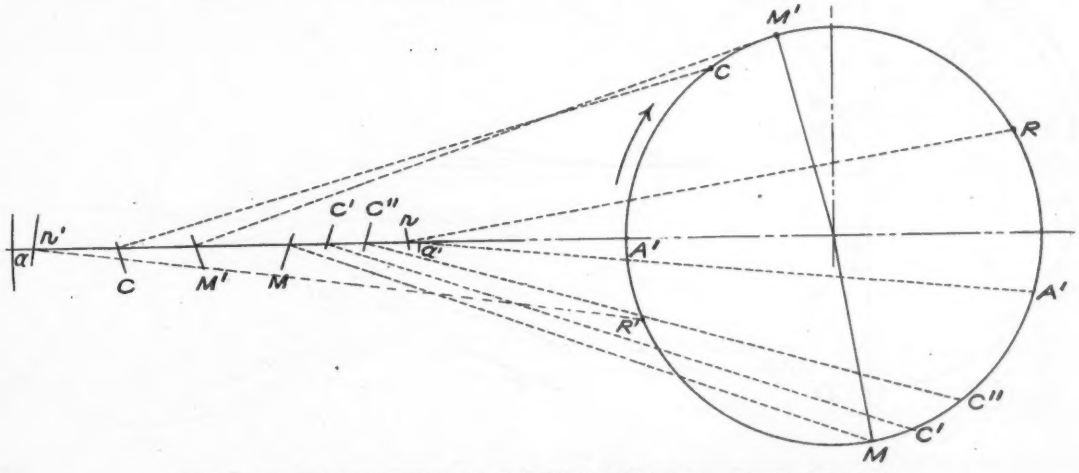


FIG. 1. CRANK AND CROSSHEAD POSITIONS FOR EARLY CUTOFF PROBLEM

From Q as a center, the exhaust lap will come to touch OR and will be 1 15-16 in. and carrying a crank line to touch this circle on the other side gives OM the crank position at release. This transferred to Fig. 1 gives M as the cross head position.

Looking at the work so far, it is evident that the large lap and eccentricity required are ridiculous, and compression comes much too early. By making the maximum port opening less, the lap might be made a little smaller, but not enough to help matters much. It will be found by trying the same problem for other cutoffs that the limit for satisfactory proportions and working is at about ⅝ stroke.

Difficulty on the Crank End

PASSING to the crank end, Fig. 3, positions C′ and R′ are transferred from Fig. 1. As the angle of advance and the eccentricity have been fixed in Fig. 2, the position of center Q′ is taken from that, and to get a steam lap circle touching OC′ requires a lap of 2.5 in. But this gives an admission position OA′ which involves a lead of 9-16 in. and transferred to Fig. 1 would make the valve open while the piston is 0.5 in. from completing the forward stroke.

On the other hand, if lap be proportioned to give equal lead, it will be 3 in. and cutoff will come at OC″ or transferred to Fig 1 at C″, which is only 1.5 in. or 15 per cent of stroke instead of the needed 25 per cent.

Examining the exhaust it is found that the lap required for the head end to bring release at crank line OR, corresponding to 95 per cent is 1 15-16 in., and this throws exhaust closure on crank line OM which will give compression for 65 per cent of the return stroke and bring the final pressure much too high.

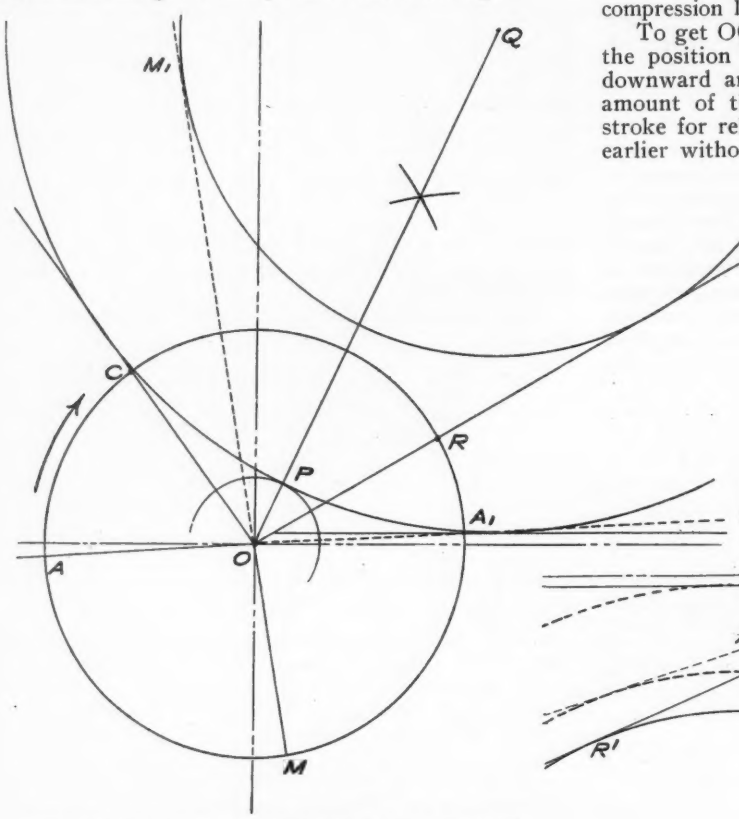


FIG. 2. VALVE CIRCLES FOR HEAD END OF VALVE

On the crank end the exhaust lap would need to be 2¼ in. which brings compression for 55 per cent of the stroke.

The conditions are therefore impossible, but it is interesting to study what can be done to meet them as closely as possible.

The early cutoff required has resulted first in an abnormally large eccentricity and laps; second in impossible exhaust conditions. The inequality of lead and cutoff between the 2 ends cannot be remedied, and a compromise of unequal leads and cutoffs is the best solution. This will apply no matter what changes may be made to get somewhere near the required conditions in a usable engine, so that the head end only may be studied.

Effect of Changes

IN Fig. 2, if we try to cut down lap and eccentricity, it can be done only by moving lines OC and OA nearer together. Moving OC to the right will mean later cutoff and moving OA upward will mean earlier admission. As the object of the early cutoff is to get expansion of steam in the cylinder, it is not wise to sacrifice this, and it is impossible to cut down the lap and eccentricity without bringing cutoff later.

By reducing the maximum port opening, the lap circle will become smaller, and this port opening needed can be reduced by lengthening the port across the cylinder and by using a multiple ported valve to give large area with small motion. This is the method adopted in automatic single valve engines.

To get release and exhaust closure into workable shape, it will be necessary to find some way to swing line OQ nearer to OR or OR nearer to OQ, for OR and OM_1 are at equal distances from OQ and to bring compression later, OM_1 must be moved to the right.

To get OQ over toward OR, while keeping OC in the position of Fig. 2 will mean letting OA swing downward and bring admission later; but a certain amount of this is allowable. Also, 95 per cent of stroke for release is late enough so that it can come earlier without serious loss of power.

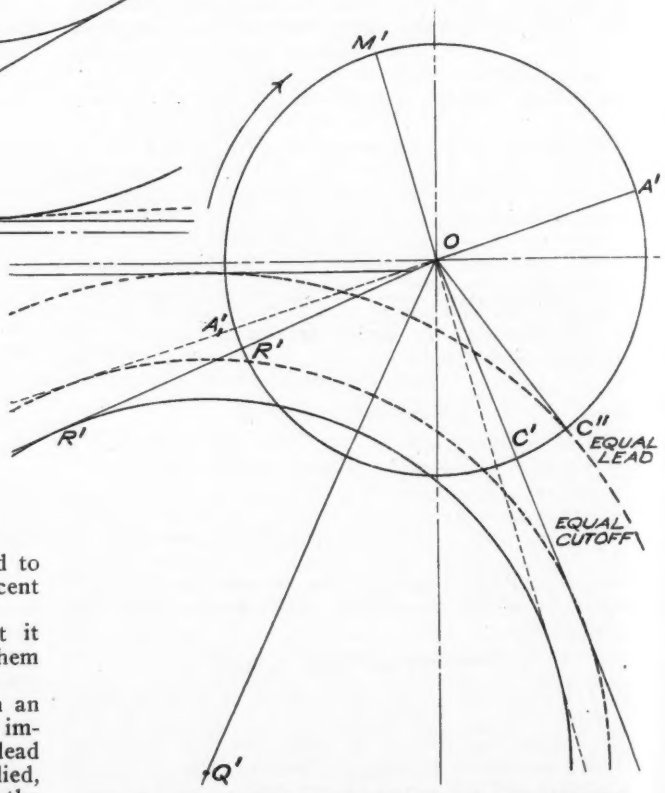


FIG. 3. CRANK END VALVE CIRCLES, LEAD OR CUTOFF EQUALIZED

To figure a little as to how far we may go in these changes, suppose that the engine is to run at 175 r.p.m. and has a piston 10 in. diameter. Piston speed will then be 175×10÷12×2=290 ft. a minute, about. As the allowable speed of steam through the ports is 6,000 ft. a minute the area of port is to area of piston as piston speed is to 6,000; piston area is 78.54 sq. in. for a 10-in. piston, hence port area:78.54::290:6,000, and by the working out of the proportion, port area=78.54×290÷6,000=3.796 sq. in.

If the port be as long as the cylinder diameter, 10 in. this will give a port opening of 3.796÷10 or 0.3796,

which is larger than the ⅜ in. stated in the first place. By making the valve double ported, the opening required can be reduced to 3-16 in. which will help materially.

As the crank end cutoff comes too early with the lead as specified, it will be possible to let that come later, also cutoff in the head end later without reducing the average cutoff below ¼. Also letting OQ and OQ′ swing toward the center line will improve lead conditions in the crank end though bringing admission late in the head end.

A Possible Compromise

TO see the effect of these changes, assume the double port with 3-16 in. maximum port opening, permit head end cutoff to come at 0.33 stroke with negative lead of 1-16 in. and crank end lead of ⅛ in.

Then in Fig. 4 we establish c as the cutoff point for the head end and this gives C as crank position. The lead for the head end will come at 1-16 in. below the center line and the circle OP will have a radius of 3-16 in. By trial we establish the center for the lap circle at Q and the length of the steam lap as QC, which is 1.75 in. Prolonging OQ gives the center Q′ at a distance equal to OQ from the point O and compression at M′ which gives a crosshead position m′ at 35.1 per cent from the end of the stroke.

By comparing these figures with those of the first diagrams, Figs. 2 and 3, it will be seen that the conditions are much more even, but the cutoffs are still somewhat unbalanced, the lead is twice as much at one end as at the other, compression is too early on both ends and is unequal. We have compromised about as far as can be done in the line of cutting down port opening. Further change would need to be in the direction of letting the cutoff run unequal, allowing lap and eccentricity both to be larger and making the clearance at the 2 ends of the cylinder sufficiently unequal to take care of the difference in point of exhaust closure and consequent amount of compression.

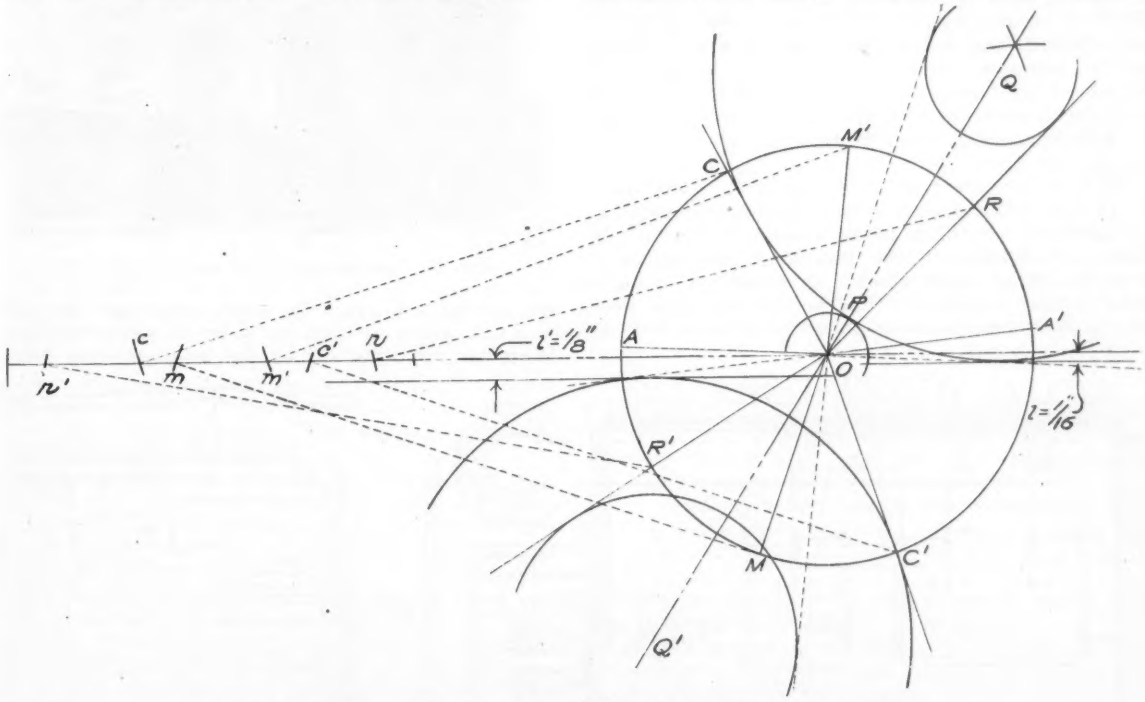


FIG. 4. DIAGRAM FOR COMPROMISE CONDITIONS WITH EARLY CUTOFF

and taking the lap for the crank end as ⅛ in. positive, we get the steam lap circle for the crank end tangent to this line and establish the position C′, crank position at cutoff for the crank end. This gives us c′ as crosshead position, which is at 26.3 per cent of the stroke from the crank end head point; r, which is release position when allowed to come at 0.9 stroke, gives us R, crank position at release for the head end. The exhaust circle tangent to this gives 15-32 in. as the exhaust lap and the compression line M transferred to the crosshead line gives m as the compression point for the head end, which is 41.3 per cent from the end of the stroke.

The exhaust lap on the crank end is established with r′ at 0.9 of the stroke, giving us a lap of ⅞ in.

WHY IRON RUSTS

BRITISH investigators estimate that the rails of a single railway system in England lose 18 tons in weight every day, and that the larger part of this loss is due to the effects of rust. The problem of rust is of great economical importance, not only because of such losses as that just mentioned, but also because of the great expense involved in repainting iron and steel structures in order to preserve them. Thus $10,000 a year is spent in painting the great Scotch bridge over the Forth. Recent experiments indicate that pure iron in the presence of pure oxygen does not rust. It appears to be necessary for the production of rust that some acid, notably carbonic acid, shall be present. When iron is subjected to the action of water containing traces of acid, and in the presence of atmospheric oxygen, it always rusts. The rapid rusting of iron in railroad stations is ascribed to the presence of sulphuric acid derived from the smoke of locomotives.—Harper's Weekly.

"BRAIN POWER in a factory counts for more than horsepower."—Chalmers.

POWER PLANT AND PIPING OF THE BOSTON BEER CO.

BOILERS AND BUILDINGS

THIS power plant designed and supervised by F. W. Dean is planned for taking care of both the present requirements, with a reserve for emergencies and also for future extension. The building, stock, breeching, piping, etc., are all large enough to accommodate 2 batteries of 2 150-hp. Stirling boilers, a total of 600 hp. At the present time 1 battery of 2 boilers and ½ battery of 1 boiler have been installed.

The boiler house, brick with stone trimmings, is 54 ft. long by 42 ft. wide, and 25 ft. 3 in. from floor to under side of trusses. On 1 end there is a pump and toilet room 12 by 29 ft. The boilers are arranged on 1 side of the boiler room leaving a 16-ft. firing floor. Steel trusses supported the roof, and on them rest wooden purlins, the roof plank being spiked to these. The roof pitches 2 ways from the center and has inside gutters and a parapet wall extending around the entire building.

Mr. Dean has made liberal provision for light and air. In the wall opposite the boilers are 3 openings each 10 ft. wide by 24 ft. 6 in. high to the top of the arch. Ten ft. above the floor is set an 8-in. channel, and the opening to the top is closed with 16-light sash and an arched transom. The 2 side openings below the channel are fitted with steel and rolling doors and the middle opening with large wooden doors with paneled side frame.

All 3 boilers are connected with a Custodis stack of 5 ft. 6 in. inside diameter by a sheet steel breeching 4 ft. wide and varying in height from 4 ft. 6 in. to 6 ft. There is a damper in the breeching just before it leaves the boiler room which is governed by an automatic damper regulator. The boilers are hand fired and the fuel is delivered to an enclosed yard in front of the boiler house.

as far as possible. All condensed steam and trap discharge is returned to a tank located at one end of the pump room on a platform about 9 ft. above the floor,

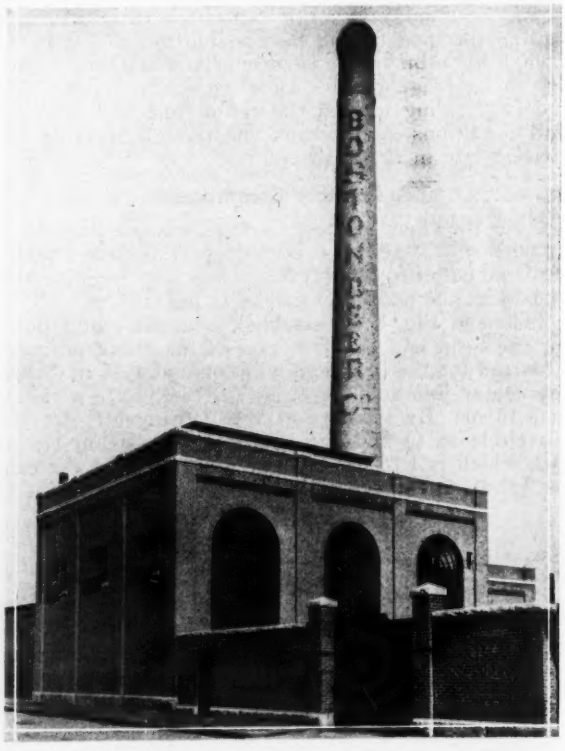


FIG. 2. BOILER HOUSE OF BOSTON BEER CO.

and having a 2½-in. city water connection governed by a float valve to keep the water at a constant lever. There are duplicate 7½ by 4½ by 10-in. feed pumps

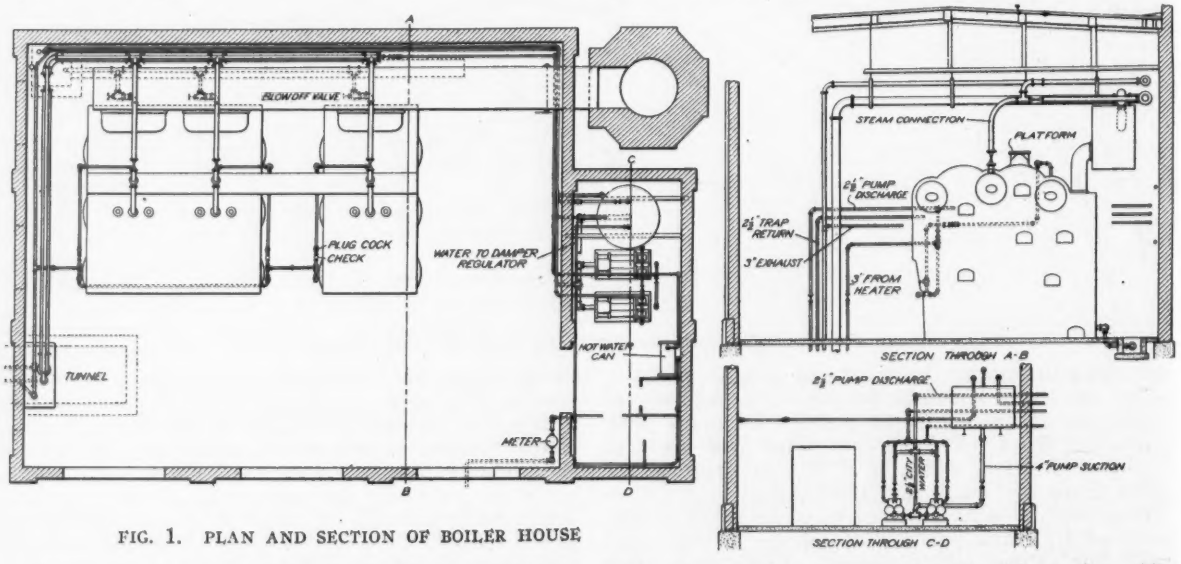


FIG. 1. PLAN AND SECTION OF BOILER HOUSE

Accompanying cuts show clearly the neat appearance and compact arrangement of this plant.

Piping

AS water has to be purchased from the city and settlement made on the basis of meter readings, every effort is made to use the water over and over

with 4-in. suction connected with this tank. The valve arrangement makes it possible to use either pump as required.

The pump discharge is 2½ in. and leads around the boiler house, through a tunnel to the engine room across the street, where a heater is located. The

heater discharge is 3 in. and leads back through the tunnel to the boiler house. There is a bypass between the 2½-in. line to the heater and the 3-in. return, so that it can be cut out in case of emergency and the pumps feed direct into the boilers. The boiler feed main is 2½ in. with 2-in. branches to each boiler. From each boiler there is a 5-in. steam riser sweeping in a bend of 24 in. radius towards the rear of the boilers.

This bend leads into a tee, from which branches a 4-in. auxiliary live steam line, both this line and the 5-in. line leading to the 8-in. steam main having valves so that either line can be used independently and any boiler can be cut out entirely.

Both the 8-in. steam main and the 4-in. auxiliary lead through the tunnel under the street to the engine and refrigerating rooms where the steam is distributed when needed. This auxiliary line was installed so that it could be used for running part of the plant. It was also a safety device, so that there will be no shut down of the plant for repairs to the main steam line. A 2-in. line connected with both the 8-in. and the 4-in. auxiliary takes steam to the feed pumps and also is used to heat water for the shower baths and wash basins which are located in the pump room.

A 42 PER CENT SAVING IN LUBRICATION

AS AN example of what may be saved in lubrication cost a report by Arthur D. Little, of Boston, is particularly interesting because of several features making for economy.

The 7 engines, together with the shafting and separate machines were well equipped with oiling devices, drip pans, etc. The engines were run on an amount of oil so small as to offer no opening for saving in that direction; and there was a certain amount of system in the handling of lubricants and a general effort at economy in their use. Nevertheless, the report showed the way to further economies which made a cut of over 41 per cent in the annual lubrication expense. The manner in which this was done is worth study.

In the year before this report was made, this plant had used 18,500 gal. of different oils, and 4,675 lb. of greases and gear coatings, at a total cost for the year of $4,425. Analysis of these oils and greases showed that all were of good quality. It also showed that the highest priced oils were very close in all essential qualities to some of the other oils which cost much less. "Machinery oil," at high price proved to be practically the same thing as low priced "shafting oil." It was evidently quite practicable to substitute for these 2 oils 1 oil, for which the Little report gave specifications, that could be bought by annual contract on specification, for about the price of the former "shafting oil." This much less expensive oil was satisfactory for the engines and high speed machines and shafting. For the low speed machines and shafting the report gave specifications of a good grade of black oil, obtainable for a few cents a gallon.

Similar treatment was given to the grease problem. The high temperature of the summer months caused this to run off the gears rather freely, and this meant increased consumption. By using a stiffer grease this loss was avoided so successfully that a cut of 25 per cent in the annual grease consumption was made possible, and it was shown that the desired quality of grease could be bought at less than the previous minimum price.

Greater economy in the handling of oils was also devised. Oils were issued from the storehouse by the barrel, on requisition. After leaving the storehouse, the barrels of oil were kept in the different departments. Several barrels were found to be leaking, this causing waste. The first change advised in this matter was the construction of an oil house in which the whole supply of oil should be kept in metal tanks provided with key faucets and drip pans. Oil was to be emptied from the barrels into the tanks as soon as received at the plant. Another step was to provide gaging and outage sticks so that the amount of oil actually in each barrel could be measured when a shipment was received. This procedure is rarely carried out at a plant, but it often produces substantial savings. The next step was a better method for recording the amounts and place of use of oil distributed. Previously there had been no simple and centralized system for keeping these details on record, or giving any quick and easy way of figuring up consumption and cost. The report made it possible to stimulate economy in use by making each engineer and foreman face his own costs.

Of actual waste, there was one instance in the loss of engine oil, which for the 4 large engines of the plant ran up to about 150 gal. a month. Most of this waste was attributed to wiping up the engine frames and floors with waste, which was then thrown away or burned. For stopping this loss, the report advised the use of a waste and oil saving machine, which made the waste fit for use over again, and recovers a large part—often as much as 90 per cent—of the oil held in the waste.

Reduction of the cost of the oils and greases; the use of lower grade oils where such were good enough for the particular purpose; and the abolition of waste enabled the experts to demonstrate for this plant a saving in the annual lubrication expense of nearly 42 per cent—or in other terms a cut from $4,425 to $2,570.

TWO LIGHT-WEIGHT ALLOYS

TWO remarkably light-weight alloys just introduced into industry are "metal cork" and electron. Both are considered superior to aluminum.

Analysis shows metallic cork to consist of 90.30 per cent magnesium, with zinc, sodium, aluminum, and iron. The density of this alloy is 1.762, while that of magnesium is 1.74.

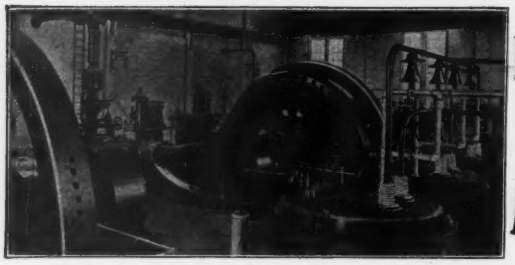
When this grayish white alloy comes in contact with water it frees a certain amount of hydrogen.

Electron has not as yet entered commerce. Its base is aluminum. This metal will be used in making the body of the new Zeppelin airship.—Harper's Weekly.

AN ANNOUNCEMENT IS MADE of the formation of a new advertising firm by the name of Dudley Walker & Co., under the management of Dudley Walker, for many years connected with the Chicago & Alton Railroad as general advertising agent, until his resignation took effect on July 1. In his connection with railroad publicity Mr. Walker made many strong friends in both the railroad, commercial and literary fields. Offices have been opened at 1253 People's Gas Building, where the new firm is equipped properly to handle the newspaper, magazine and outdoor general agency business. Mr. Walker's many friends will unite in wishing him success in his new undertaking.

IMAGINATION PRECEDES and is the cause of all achievement.

ELECTRICAL



MACHINERY AND APPARATUS

COMPARATIVE TESTS OF LIGHTING SYSTEMS

By J. G. Henninger

IN these days of intense business competition when the "survival of the fittest" is a grim reality, men all over the country, who aim to be keenly alive to all of the economic principles involved in the efficient operation of a manufacturing establishment, are realizing the importance of a good lighting system. of industry are turning night and day, a good lighting system is absolutely essential. Men cannot and do not produce equally well under poor light and good light. Good light is as essential as good sharp tools. Aside from any humanitarian reason for good light, it has been definitely and absolutely proven that in the opera-

FIG. 1. SHOP OF OHIO SEAMLESS BRASS CO. LIGHTED WITH SHELBY MAZDA ARCS

A few decades ago little work was carried on after night, so that an extensive lighting system in most factories was not necessary; but now that the wheels tion of mills and factories a scientific lighting system will increase the output of the after-dark hours by 14 per cent. This figure was obtained by careful

observations in over 20 mills, representing a diversity of industries. This figure alone may not mean so much, but let us consider what it means in one year. Of the 2400 working hours of a year, about 480 are after dark or on gloomy days when artificial light is needed; 14 per cent of this is 67 hr. This actually represents the number of hours of labor wasted by the use of poor and insufficient light. A proper lighting system should appeal to every mill superintendent, foreman or engineer.

Many of the accidents which have happened in our mills in the past have been caused by poor lighting conditions. Aside from accidents, much nervousness and eye trouble can be blamed on poor lighting conditions. Managers who have kept careful record of the effect of good lighting on the character and amount of work done have found that it pays to light up thoroughly.

The Ohio Seamless Tube Co. has recently installed an interesting lighting system in its mills at Shelby, Ohio. The building which is lighted is a large steel structure 360 ft. in length by 100 ft. in width, having a clear height of 29 ft. 9 in. to the bottom of the roof trusses. Traveling electric cranes run the entire length of the building so that electric lighting must be done from above the crane area.

Many different types of lamps have been used at various times by the Ohio Seamless Tube Co. with more or less success. In its mill, as in many others of its kind, the common enclosed carbon arc lamp was for a long time the principal source of light. The carbon arc was followed by the mercury vapor lamp and then by the flaming arc, and now the last step has been from flaming arcs to Shelby Mazda Arcs.

As Fig. 2 shows, these lighting units are each comprised of a cluster of 4 lamps fitted with a metal reflector having a white enameled reflecting surface, which is durable and efficient. The lamps are regular type street series Mazda, arranged to burn 4 in series on 110 volt circuit.

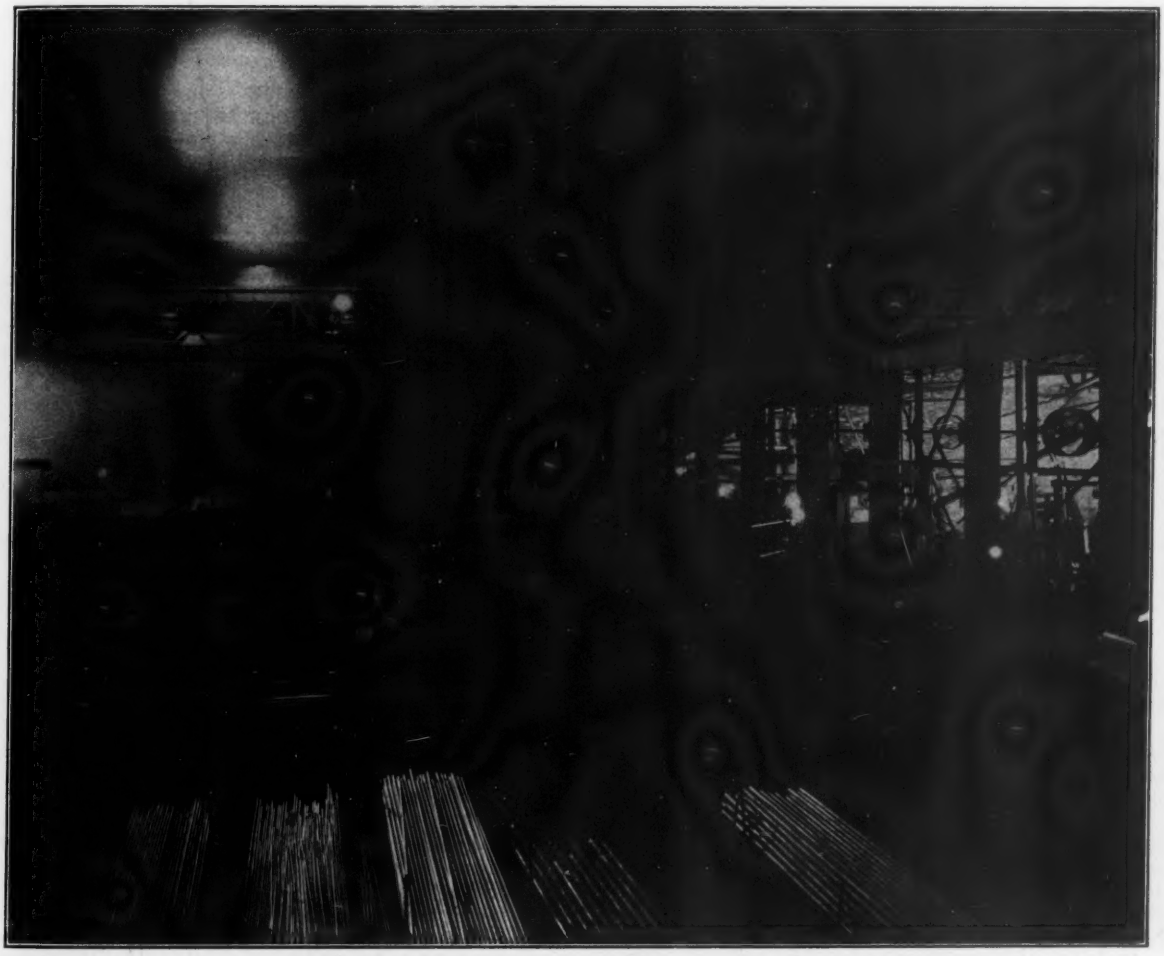


FIG. 3. LIGHT DISTRIBUTION IN SHOP USING FLAMING ARC LAMPS

In this particular installation, 2 sizes of units are being used; one, a 1000-watt unit containing 4 250-watt Mazda lamps; the other a 400-watt fixture, containing 4 100-watt Mazda lamps. The large units are being used along the center of the building suspended from the roof on about 40-ft. centers and at a height of 30 ft. from the floor. The smaller units are being used along the sides of the building where special lighting is necessary. The entire section equipped with the large Mazda clusters is brightly and uniformly lighted. There are some few machines, where individual lighting is necessary, but for the most part the general lighting easily meets all demands.

The Tests

IN order to find out exactly how the Shelby Mazda Arc compared with the flaming arcs, a test was made. The intensity of illumination produced by each of the 2 types of light source was measured by an illuminometer at a large number of points chosen at regular intervals along the floor. At the time of the test one end of the building was lighted with flaming arcs while the opposite end was lighted with Shelby Mazda Arcs. Arrangements were made so that each type of lamp should have the same power consumption, each should light an equal area, and should be located at the same height above the floor. Furthermore, at the time of the test, each type of lighting units had been in continuous service for several months. The test was therefore run under actual operating conditions, which were as nearly identical as it is possible to make them.

FIG. 2. MAZDA CLUSTER

The results of the test were decidedly in favor of the Madza lamps, for not only was the average intensity of illumination 12 per cent higher than that produced by the flaming arcs, but the distribution of light was more even. Furthermore, the Madza light was of a constant color value and did not vary in intensity; that is, there was no flickering. During the test the intensity of illumination produced by the arcs frequently varied over a range of 245 per cent several times a minute. The lamps would burn with a fair degree of steadiness for a short interval of time, and then, as the carbon burned away and the arc lengthened, the regulating mechanism would come into play with a corresponding variation in the intensity of light emitted. The frequency with which the arcs had to be trimmed was a sore spot with the plant electrician and caused him to welcome the change to incandescent lighting. Trimming the flamers was also a continual source of heavy expense. Carbons are expensive and the labor involved in trimming and adjusting amounted to several cents a day. With the incandescent cluster, absolutely no trimming or adjusting is required, The lamps live an average life of 1,320 hr. and may be renewed at considerably less expense than the cost of carbons for the flaming arcs.

The employes are so well pleased with the new lighting system that they are asking for it in those sections of the plant which have not yet been equipped. Employes welcome Mazda lighting because of the daylight quality of light which it gives. The bluish light of the mercury tube and the harsh glaring light of the flaming arc is not welcomed by operators as it is not natural, or near natural. Artificial light, at best is not as good as natural daylight, but Shelby Mazda approximates daylight closely. Operators need good light to be most productive and it would seem as though the Mazda Arc would be well adapted to shop lighting as proved in the above example.

DYNAMO AND MOTOR TROUBLES

By John A. Voss

SPARKING at the brushes is one of the most common dynamo and motor troubles, notwithstanding the large amount of attention that has been given to the analysis of the principles of commutation and the resulting excellence of design.

No matter how well a dynamo or motor may operate when first installed, hard service and careless handling will develop sparking at the brushes.

Sparking may result from one or more of the following causes:

The brushes may not be set exactly at the point of best commutation. With a good make of dynamo or motor, not overloaded, a position can always be found where there is practically no sparking, and here the brushes should be set.

The brushes may be wedges in the holders if they are of the box type.

The brushes may not be fitted to the circumference of the commutator.

The brushes may not bear on the commutator with sufficient pressure.

The brushes may be burnt. This usually indicates that the connection between the brush and holder is not fastened securely.

The commutator may be rough and, if so, must be smoothed.

A commutator bar may be loose or project beyond the others.

Commutator may be dirty, oily or worn down so far that the bars are mechanically unstable.

The machine may be overloaded.

There may be a loose connection or open circuit in the armature which would cause a long, bright spark, apparently extending around the commutator and leaving a scar at the point of open circuit.

There may be a short circuited coil in the armature. This causes a heavy intermittent spark to appear at the brushes, which is very destructive to the brushes. A short circuited coil is very easily discovered by shutting down the machine, an excessively hot section will indicate the point of trouble.

The brushes may not be equally spaced around the commutator. The spacing can readily be determined by marking their positions on a strip of paper which may be placed around the commutator under the brushes.

Failure to excite or build up is a common fault with new generators, and occasionally with those that have been in service. If upon starting, the generator fails to show any voltage when running at normal speed, examine the field circuit to see that it is not interrupted by an open switch, a poor connection or a defective rheostat.

A magneto may be used to test the field circuit, but if the machine will not ring through the high resistance of the field winding, sections of the field may be taken, a coil at a time, going completely around the field magnet. If the field and armature circuits are complete the fault may be due to a reverse connection; this can be shown very easily by opening the shunt field switch; if the voltage rises slightly and then falls again upon closing the switch, this indicates that the residual magnetism is opposed by the shunt field winding; reverse these connections and the generator should build up satisfactorily.

A simple method of getting a compound machine to build up is to short circuit the armature through the series field winding with a fuse in the circuit having a capacity half that of the machine. If the fuse is not melted there is a defect in the armature; if the fuse is melted and the machine still refuses to excite itself, the defect is probably in the shunt field winding.

Grounds may occur on the line from which current is delivered or to which it is supplied, or within the machine itself. To test for a ground use a number of incandescent lamps, the combined voltage of which is equal to that of the machine. Place one terminal of the lamp bank first on a positive, then on a negative brush of the machine, the other terminal being well grounded; if the lamps light up, there is a ground on the line; if, however, the frame of the machine is not insulated from the ground, this method will not distinguish a ground on the line and one within the winding of the machine. If the frame is insulated from the ground and the terminal previously grounded is attached to the frame, the other terminal being applied as before, the lamps will show whether the core of the armature or field magnet is grounded.—The Generator.

ISOLATED PLANT COST

AS showing what may be done by careful management and co-operation on the part of the engine room force, the records of the power plant of the Security Mutual Life Insurance Co.'s building at Binghamton, N. Y., in charge of Chief Engineer Asa P. Hyde are a good object lesson.

All expenses, coal, labor, oil, waste, polish, paint, mops, brooms, pails, soap—in fact, everything used in the plant—are charged against the plant generators; and they are credited with the output as shown at the switchboard.

The plant supplies the building with light, heat, ventilation, elevator service, water service, repairs on plant in engine room and building, additions to lighting or heating service, as well as the same service for the Carnegie Library Building and the Phelps Building.

RECORD OF POWER PLANT IN OFFICE BUILDING

MONTH	COAL, POUNDS			KILOWATT HOURS			ELEVATOR TRIPS		
	1907	1908	1909	1907	1908	1909	1907	1908	1909
OCTOBER	221,269	210,185	216,018	23,890	28,130	29,910	21,947	28,046	21,385
NOVEMBER	223,371	214,731	226,034	21,610	30,000	34,910	21,127	19,937	21,139
DECEMBER	225,669	222,980	231,093	24,930	35,090	36,770	21,641	21,133	22,614
TOTAL	670,309	647,896	673,145	70,430	93,240	101,590	64,715	69,236	65,138

This plant has given 24-hr. service for 5 yr. and 4 men, including the chief, do the entire work. One man's time is largely taken up in the care of the plunger elevator system, the heating and ventilating plant and motor equipment. Everything is kept up in shape all the time so that there is never need for a general overhauling and the efficiency does not run down.

Results are what count, and in this case the count is good. The table shows how the total load and fuel have varied for 3 months of 1907, 1908 and 1909. In Sept., 1908, the Phelps Building load was added and in Oct., 1909, the Carnegie Library lighting, heating and hot water service came on the plant; but in neither case was additional help put on.

Cost per kilowatt-hour with all items figured, as already specified, has run from 2.5 cents to 1.08 cents, the lowest point being reached in 1909 after the load was all on. The record is one which Chief Engineer Hyde and his staff have a right to regard with satisfaction.

It is notable that in 1909, 25,246 lb. more coal were used for the specified period, while 13,350 kw.-hr. more were supplied. The fuel increase was thus 3.8 per cent and the load increase 14 per cent.

For 1909 over 1907, the fuel increase was 0.4 of 1 per cent and the load increase 33 per cent.

BOILER EXPLOSION AND THE MOTOR DRIVE

AS a means of power supply for practically every purpose, the electric motor drive stands available. In many instances, the nature of the work or the location will admit of no other form of power application, and even where some of the circumstances are favorable to mechanical drive, the electric motor has its advantages. One of these advantages was demonstrated after the explosion of the boilers of the Pabst Brewing Co., Milwaukee, Wisconsin.

Four of the 8 400-hp. boilers were completely wrecked, and the entire steam plant was out of commission for several days. Hence it was imperative that power be secured from some outside source. To fill this demand, the Milwaukee Electric Railway & Power Co. was called upon for a delivery of 600 kw. to be commenced in the shortest possible time. Three transformers, to reduce the voltage from 13,200 to 440 volts, were in place a few hours after the explosion, and by midnight of the same day current was being supplied to all the needed motors.

The brewing plant is electrically operated throughout; it employs nearly 150 Westinghouse 3-phase, 25-cycle, induction motors, ranging in capacity from 0.5 to 50 hp., and totaling nearly 2000 hp. rated capacity. That the motor equipment was so complete proved fortunate at the time of the disaster, for, by means of the connection which was made with the central station, the work in practically all departments was resumed at once. Thousands of bushels of grain in progress through the different stages of brewing were saved from spoiling, and 300 people were enabled to work on continuously. The short time which it took in this case to arrange a temporary source of power is a striking tribute to the advantage of electric drive in such an emergency.

A VERY SATISFACTORY way to sharpen files is to clean them of all grease and suspend them from a metal plate in a bath of 3 parts of sulphuric acid, 6 parts of nitric acid and 100 parts of water. In the bath are also immersed several carbons connected to the metal plate. The file cavities only are eaten deeper so that the edges are made as sharp as if worked by a file cutter.—Popular Electricity.

CONCENTRATE YOUR thoughts upon the troubles about the plant and its efficiency will grow.

HOW THE NEW CHIEF MADE GOOD

BREAKING GROUND AND SELECTING ENGINES

By Geo. H. Wallace

JUST 2 days after John Gautelbeim had signed the batch of contracts, the firm that was to do the excavating appeared in the factory yard with a vast assortment of implements for that class of work and in short order began excavating for the power house.

An event of so great importance as this was not allowed to pass unnoticed, for the "firm" was on hand to see that everything went according to Hoyle. All were in excellent spirits and, while the men were getting ready to begin work, the officials laughed and joked like schoolboys.

The driver cracked his whip over his strapping team of grays, and as the plow threw up the first furrow across the site of the power house Gautelbeim exclaimed: "That's a bully good start; keep it up and make the dirt fly. That's going to be the grave of mistakes that I've made the past 20 years. Let the good work go on."

In due time the excavation was completed, and while the contractor moved his outfit over to tackle the tunnel proposition, the pile driver entered the cellar of the power house to prepare for the foundations. The general nature of the soil was not entirely bad, yet piling was necessary, and ere long the continuous drop of the heavy hammer was driving the oaken timbers into place.

About the time they were finishing up, a busy little tugboat pushed, pulled, shoved and jostled a cumbersome old sand scow up along the dock and an equally busy little switch engine struggled into the factory yard with several carloads of crushed stone, brick, cement, cribbing, concrete mixers, etc., and by the time the pile driver had sent home the last pile, men were busy setting up their forms to the lines established by the transit-man under the direction of Chief Engineer Willard.

This part of the work being well under way, the clanking concrete mixer poured forth a continuous stream of the plastic mixture which shot down troughs to the basement where it was leveled off and well tamped down.

Thus the work went on, one job following right on the heels of the one before, until one could fairly see things grow, and by the time the foundations for the power house and contents and the stack were in place the cribbing and forms were all ready for the main tunnels.

In designing the concrete stack, Willard fairly spread himself, and he took particular pains to see that his designs were strictly adhered to. The base of the stack was designed with several panels, all nicely worked out with moulding, so that when finished the effect would be good. In the form of one side he had caused to be constructed with neat half-round moulding the name of the firm, its officers, and the date. When the form was removed one had to look twice to tell whether or not it was made of chiseled stone. The same effect was carried throughout the entire stack, and surmounting the whole was a neat and inexpensive capitol. At a short distance the stack resembled the columns of some ancient Greek temple more than the smoke stack of a hustling Yankee manufacturer.

The tunnel was another thing on which Willard let his fancy work freely. It was commodious in every way, with ventilators leading to the open air where they could not be interfered with by any possible emergency that might arise. At one place was constructed a slot in the roof, about 20 ft. long and the same number of inches wide, through which the heavier pipe that would be required in the tunnel could be lowered.

Through it all Willard was always on the job and seemed to be everywhere at once. He kept an ever watchful eye on the contractors to see that they did not "load him up" with an inferior cement delivered in "A" grade Portland cement sacks. Then, again, some contractors sometimes forgot to put any cement at all in concrete work, or else put in a double dose of sand. All these little things required the closest attention. It was stipulated in the contract that no mixture of concrete would be allowed in the structure any place that had been mixed longer than half an hour before being put in place. Failure in concrete work had occurred all too frequently from keeping the mixture wet too long before putting it in place, and Willard would take no changes.

Along came the boiler contractor's blue-prints, and the foundations were put in place. All these things kept Willard extremely busy, but he never for a moment lost his quiet, even manner; and, if he had anything to say, he said it and made no bones about it.

One day a little incident occurred that showed the contractors that no flim-flam work would go. A carpenter was setting some window frames in the power house and plumbing them with a level so much out of true that the amount the window was out of square, or rather out of plumb, could be seen by the eye. Willard stopped the work and looked at the level.

"Where did you get that level?" he asked.

"What's it to you?" replied "Chips," much injured in his dignity. Just then the contractor came up.

"Here, contractor, take this man off the job at once," said Willard.

"Not by a ——" said the contractor. "What for?"

"Either let that man go, or take them all off the job."

"Say, what's the matter with you? Why?"

"Look at this clause in your contract," said Willard, as he quickly dug up a duplicate out of his pocket. " 'The party of the first part reserves the right to pass final judgment on the quality of work done by party of the second part and his employes, and may take such measures as he may see fit to insure the contract being completed expeditiously in the most skillful manner possible.' Isn't that clear, Mr. Contractor? Now take that man and his 25-cent level off the job at once. We are not going to have the work done around here in any other way than the best."

And the man got off the job. This little affair speedily became noised around and every man on the job saw that there was just one man running things around there, and his name was Willard. Besides looking after things in the plant, he occasionally inspected his new boilers at a neighboring city and looked over large power houses in the vicinity to get possible new ideas. And with all his care he still had time to spare to visit the Gautelbeim mansion more

or less frequently—usually more—and on each succeeding visit it was noted that he spent less and less time in the library with John and more and more time in the parlor with Dorothy, while the latter played the latest operatic music for him and sang the latest songs.

"Well, Willard," said Supt. Mather one day as he strolled into the old engine room where the chief made his office, "how are you getting along on the engine proposition?"

"Well, Mather, it's quite a problem, no mistake. Some time ago I sent to 8 or 10 engine companies a little list stating our requirements and other details and asked them to send me the dimensions of engines they would supply to develop 750 and 450 kw. respectively. The engines were to be cross-compound, direct connected to the generators (240 volts), steam pressure 165 lb. at the throttle, double eccentrics, and strong enough for 2 reborings and still stand up to the work.

"I stipulated, also, that we would use our exhaust steam about half of the time and the remainder of the time would run condensing. Also that speeds must range between 100 and 125 r. p. m.

"Now, out of the several firms I wrote, some of them didn't think it worth while even to drop me postal card to say that they had received my letter and had thrown it in the waste basket. Well, that's all right, I guess; but they don't need to be so independent all at once.

"Well, here's a funny proposition, Mather. I've gone over these various lists from those who were kind enough to reply and have prepared a sort of 'general specification' sheet and arranged the various bidders in different columns. However, one bidder said speeds of 100 r. p. m. and over were impracticable for any Corliss valve gear and submitted one at 90 r. p. m., so I dropped him out. Another submitted a bid on a tandem, so that left him out, and another wanted to sell us a non-releasing gear valve engine, so it finally simmers down to 5 firms, and these 2 lists are their propositions.

"Say, I never for a moment thought that there was such a difference in opinion on what constitutes an engine of a given capacity. I know that if we all had the same opinion we would all want the same engine——"

"Or the same girl," put in Mather with a smile.

Willard blushed, but quickly recovering himself, smilingly went on—

"—As I was saying, we would all want the same engine. Now, here," picking up the general specifications of the 2 units, "here are 4 firms proposing to build a 750 hp. cross-compound Corliss engine. One proposes a 26 by 48 by 42, at 100 r. p. m., the second a 23 by 42 by 42, same speed; the third 22 by 40 by 42, at 125 r. p. m., and the fourth bidder—the odd fellow—a 22 by 40½ by 45, at 116 r. p. m. Now just look at the variation. There seem to be no standards to engine building at all. For instance, look at the receivers. One says 'twice the volume of high-pressure cylinder is about right;' another, 50 cu. ft., another 1.5 times the volume, and the fourth 2.5 times the volume. Now, if 1.5 volumes is right, why make it larger? If 2.5 volumes is right, why make it twice or 1.5 volumes—or even 50 cu. ft., as one specifies?

"One is going to use an 18 by 36-in. main bearing and the 'odd fellow' only 12 by 24-in., with a shaft only 13 in. in diameter in the hub, and the first fellow has to use a 21-in. shaft, and for a wheel No. 1 uses a 65,000-lb. wheel, and No. 4 one of 30,000 lb., less than half, for a speed of only 16 r. p. m. more.

"Then on type of shells in bearing one says '4-piece bearing' (which is quarterboxes, top shell and solid bottom shell); another doesn't say whether his engine has any main bearing at all or not; the third bidder says his is a 5-piece shell—the bottom shell being 2-piece, the top of which can be rolled out around the shaft by simply raising the shaft 1/16 in. Now that idea looks mighty good to me, Mr. Mather—mighty good. The fourth bidder uses a 3-piece bearing adjusted by 2 screws, but is a little foggy in his proposition as to how it is going to work out in practice.

TABLE I. DIMENSIONS OF CROSS-COMPOUND CORLISS ENGINE TO BE DIRECT CONNECTED TO A 750-KW., 240-VOLT DIRECT-CURRENT GENERATOR. STEAM PRESSURE 165 LB. AT THE THROTTLE. OPERATING CONDITIONS, 26-IN. VACUUM 6 MONTHS AND 3 LB. GAGE BACK PRESSURE 6 MONTHS EACH YEAR. DOUBLE ECCENTRIC. CYLINDER TO BE STRONG ENOUGH FOR ORIGINAL CONDITIONS AFTER 2 REBORINGS

GENERAL SPECIFICATIONS	1ST BIDDER	2ND BIDDER	3RD BIDDER	4TH BIDDER	5TH BIDDER
DIAMETER H.P. CYLINDER, INCHES	26	23	22	22	25
" L.P. " "	48	42	40	40½	46
STROKE, INCHES	48	42	48	45	42
R.P.M. 100 TO 185 PREFERRED	100	100	125	116	100
DIAMETER STEAM PIPE INCHES	10	8	8	7	9
" " H.P. EXHAUST "	12	10	9	8	10
" " L.P. INLET "	14	14	14	12	12
" " L.P. EXHAUST "	16	16	16	16	14
SIZE OF RECEIVER IN VOLS. H.P. CYLINDER & CU. FT.	2 H.P.	50 CU.FT.	1.5 H.P.	2.5 H.P. STEEL	36 CU.FT. STEEL
MATERIAL IN RECEIVER	C.I.	STEEL	C.I.	C.I. HEADS	BUMPED HEADS
DIAMETER H.P. PISTON ROD, INCHES	5	3⅞	4⅛	3⅞	4⅛
" " L.P. " "	3¾	4⅛	5⅛	4¼	5⅛
MAIN BEARING LENGTH & DIAM.	18 X 36	14 X 28	13 X 26	12" X 24"	15 X 30
TYPE OF SHELLS IN BEARINGS	4 PIECES	?	5 PIECES	3 PIECES 2 SCREWS	3 PIECES 3 SCREWS
KIND OF ADJUSTMENT	WEDGE	WEDGE	WEDGE		
SHAFT DIAMETER IN WHEEL AND GENERATOR INCHES	21	16	15	13	16
GUIDE, BORED, V OR BAR	BORED	BORED	BORED	V	BAR & SLIPPER
CROSSHEAD SHOES AREA APPROX.	300 SQ. IN.	200 SQ. IN.	11¼ X 20	9 X 16	12 X 15
MATERIAL IN SHOES	C.I. BABBIT	C.I. BABBIT	C.I. BABBIT	BRASS	C.I.
CRANK PINS "	9 X 9	6¾ X 7½	7 X 7	6 X 7	8½ X 8
CROSS HEAD PINS "	5½ X 9	4½ X 6½	6 X 7½	5⅝ X 6	5 X 7
CONNECTING ROD LENGTH ℄ TO ℄	10'-6"	10'-6"	9'-6"	11'-3"	10'-0"
FLY WHEEL DIAMETER FT.	16	16	14	12	13
" " WEIGHT APPROX., LB.	65,000	45,000	55,000	30,000	50,000
" " TYPE	30, 2 PTS.	BAL. 2 PTS	BAL. 2 PTS	BALANCE WT.	30, 6 PTS.
GUARANTEED STEAM CONSUMPTION CONDENSING	13½ PER H.P.H.	16 LB.	12¾ LB.	16 LB.	14 LB. H.P.H.
GUARANTEED STEAM CONSUMPTION NON-CONDENSING	20 PER H.P.H.	18 LB.	17½ LB.	21 LB.	19 LB.
HORSEPOWER AT FULL LOAD & PRESSURE STATED	1125	1125	1125	1135	1100
GUARANTEED REGULATION NO LOAD TO FULL LOAD	2½%	3%	1⅝%	3½%	3%
APPROXIMATE TOTAL WEIGHT OF ENGINE LB.	250,000	210,000	192,000	176,000	215,000

TABLE II. DIMENSIONS OF CROSS-COMPOUND CORLISS ENGINE TO BE DIRECT CONNECTED TO A 450-KW., 240-VOLT DIRECT-CURRENT GENERATOR. STEAM PRESSURE 165 LB. AT THE THROTTLE. OPERATING CONDITIONS, 26-IN. VACUUM 6 MONTHS AND 3 LB. GAGE BACK PRESSURE 6 MONTHS EACH YEAR. DOUBLE ECCENTRIC. CYLINDER TO BE STRONG ENOUGH FOR ORIGINAL CONDITIONS AFTER 2 REBORINGS

GENERAL SPECIFICATIONS	1ST BIDDER	2ND BIDDER	3RD BIDDER	4TH BIDDER	5TH BIDDER
DIAMETER H.P. CYLINDER, INCHES	20	18	16	15⅞	17
" L.P. " "	38	32	30	28	32½
STROKE, INCHES	36	28	42	45	42
R.P.M. 100 TO 185 PREFERRED	120	100	125	112	110
DIAMETER STEAM PIPE INCHES	7	6	5	5	6
" " H.P. EXHAUST "	8	7	6	6	7
" " L.P. INLET "	12	12	10	9	9
" " L.P. EXHAUST "	14	14	10	12	10
SIZE OF RECEIVER IN VOLS. H.P. CYLINDER & CU. FT.	2 H.P.	22 CU.FT.	1.5 H.P.	2.5 H.P. STEEL	16 CU.FT. STEEL
MATERIAL IN RECEIVER	C.I.		C.I.	C.I. HEADS	BUMPED HEADS
DIAMETER H.P. PISTON ROD, INCHES	3½	3½	3½	3	3½
" " L.P. " "	4½	3½	3½	3½	3½
MAIN BEARING LENGTH & DIAM.	14 X 28	11 X 22	11 X 22	10 X 18	12 X 24
TYPE OF SHELLS IN BEARINGS	4 PIECES	?	5 PIECES	3 PIECES 2 SCREWS	3 PIECES 2 SCREWS
KIND OF ADJUSTMENT	WEDGE	WEDGE	WEDGE		
SHAFT DIAMETER IN WHEEL AND GENERATOR INCHES	16	13	12	11	13
GUIDE, BORED, V OR BAR	BORED	BORED	BORED	V	BAR & SLIPPER
CROSSHEAD SHOES AREA APPROX.	225 SQ. IN.	170 SQ. IN.	9½ X 16	7 X 14	9 X 12
MATERIAL IN SHOES	C.I. BABBIT	C.I. BABBIT	C.I. BABBIT	BRASS	C.I.
CRANK PINS " INCHES	7 X 7	5½ X 6½	5½ X 5½	4½ X 5	6½ X 6
CROSS HEAD PINS "	6½ X 7	4½ X 5½	4½ X 6½	4 X 6	5 X 5
CONNECTING ROD LENGTH ℄ TO ℄	9'-0"	8'-6"	9'-6"	11'-3"	10'-0"
FLY WHEEL DIAMETER & FACE	14' X 16	16' X 12	14'	12'	12'
" " WEIGHT APPROX, LB.	32,000	28,000	28,000	23,000	26,000
" " TYPE	30, 2 PTS	BAL. 2 PTS	BAL. 2 PTS	BALANCE WT.	30, 4 PTS.
GUARANTEED STEAM CONSUMPTION CONDENSING	13½ PER H.P.H.	16 LB.	12¾ LB.	16 LB.	14 LB. H.P.H.
GUARANTEED STEAM CONSUMPTION NON-CONDENSING	20 LB.	18 LB.	17½ LB.	21 LB.	19 LBS. H.P.H.
HORSEPOWER AT FULL LOAD AND PRESSURE STATED	675	675	675	685	650
GUARANTEED REGULATION NO LOAD TO FULL LOAD	2½%	3%	1⅝%	3½%	3%
APPROXIMATE TOTAL WEIGHT OF ENGINE LB.	153,000	130,000	118,000	103,000	135,000

"Then look at the crank pins, running all the way from 9 by 9 to 6 by 7, with an initial pressure of 1060 to 1300 lb. per square inch on the pin respectively. And the length of connecting rod varies from 9 ft. 6 in. to 11 ft. 3 in., with a difference of only 3 in. in the stroke! Then, getting down to the bottom of the list, why can one firm get a 1½ per cent regulation and another cannot do better than 3½ per cent? I've seen men stand at the throttle all night on a steeple compound with a broken high-pressure piston valve and keep the town in lights with the low-pressure cylinder and come closer than 3½ per cent regulation. I've seen a man handle a water wheel by hand on a rolling mill variable load in one of the Southern states, and it made no difference whether they had half a dozen billets in or none; he could come closer in regulation than 3½ per cent. Now, why does a reputable Corliss engine concern advertise the fact that it can't come closer than that? That isn't regulation—that's irregulation.

"It's just the same thing with the 450 kw. propositions," continued Willard, becoming enthused with his subject. "In fact, in many respects one bidder's 450-kw. engine compares favorably—for size and general dimensions—with another bidder's 750-kw. engine. But to get right down to dollars and cents—right down to the coal, where the money is made and lost—the guaranteed steam consumption per horsepower hour is what tells the story. Now, Mr. Mather, you can chalk it right down that whoever gets the contract to supply the new engine for Baum & Gautelbeim has got to cover his guarantee with the 'good substantial,' and when we get them running the engines have got to run a test—perhaps of 24 hr., if I think it's necessary—and if they don't deliver the goods as per guarantee—well, he doesn't get all his money back, perhaps none. This is going to be understood when they sign up. On the other hand, I'm willing, and I think our firm will bear me out, to give the successful bidder a bonus, if he comes below his guarantee in steam consumption. That is but fair and square.

"But out of the entire bunch only one gave me a price, and that was $12,300 for the larger units and $9,245 for the small one in plain finish—that is with a lubricator and brass oil cups, plain guards, etc.—and $400 and $300 additional, respectively, for complete nickeled sight-feed pressure oiling system and 1-gal. cylinder oil pumps, metallic piston rod packing, indicator reducing motion, and oil proof enclosed crank and eccentric guards.

"Now, it's a hard proposition to choose right on a matter of this kind," continued Willard, "but I think it will be either this first bidder or else the third one. The former runs 100 r. p. m. and the latter 125, which makes quite a difference in generator cost to start with. I think I'll wire both these firms to send representatives down here—someone that can talk horse sense and not try to display a lot of foolish technicalities that don't amount to a pinch of snuff—and we will see if we can't settle this matter definitely within a week.

"Of course, a matter like this cannot be kept a profound secret, so to speak, for only last week I saw a brief item of our proposed extensions in Practical Engineer, and it is more than likely that there will be a salesmen's convention around this old factory before long. Well, I am not particularly prejudiced for or against any certain engine, and if some salesman comes along with a good proposition, I'm willing to listen to what he has to say—that is, if he sticks to the text and tells me of the superior points of his engine; but, if any of them try to sell their engines, not by showing up its good qualities, but by telling all the poor things that they know and don't know of the other fellow's engine, then—well—they are disqualified for the race, that's all."

After a little further discussion on the progress of the factory buildings which Superintendent Mather was looking after, the latter walked away, and Willard continued his interrupted task of designing a switchboard, while Fritz looked on in admiration for his chief, smoking an oil-agent cigar in silence. As he went back to his shaving bin singing a line or 2 of the good old Heidelberg stein song, Willard laid down his pen, touseled his hair and gave way to meditation, and there arose before his mind the vision of Dorothy Gautelbeim.

"By George," said he, as he slid from his high stool, "I've got to get a little diversion for a change, and I'm going to take her to the show tonight—grand opera or comic—anything for a rest" and he rushed out of the door.

Fritz looked at the closed door for a moment and then exclaimed:

"Now vy vos he did like dot? Bets he goes out to stiff der kickenin' out of 'noder boiler agent!" When the scene with the one some few weeks before occurred to him, Fritz laughed in glee, then went over and blew the whistle.

CAPITAL POWER HOUSE

WITHIN a few weeks the $1,000,000 power plant which will supply electricity to all the federal buildings on Capitol Hill in Washington, D. C., will be put into operation. The plant has been so built that it can carry the whole load with considerable power to spare. The building is made of brick and stone with 2 stacks each 212 ft. high. It is connected by concrete tunnels aggregating 6000 ft. in length, and high enough for a man to walk upright in, to the various buildings, which will be supplied with light, heat and power.

Four Parson turbines will be used for furnishing the electricity. They take steam at a pressure of 175 lb. and each is rated at 2000 kw. capacity, making a total capacity of 8000 kw. The battery of boilers that supplies power to the engines and heating system consists of 16 600-hp. boilers, equipped with automatic stokers. The handling of coal and ash will be done entirely by machinery and in the roof of the boiler house is a storage room for coal which has a capacity of 1000 tons.

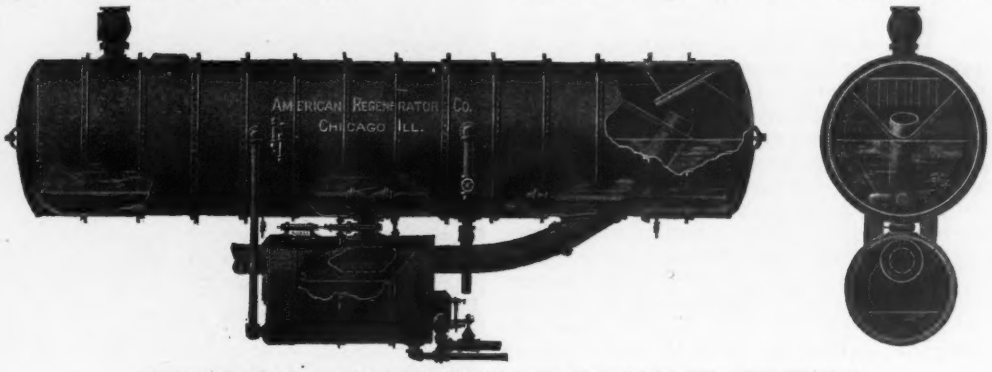
The plant is modern in every respect with automatic controlling devices and with every provision against accident. It is stated that nothing but an explosion or a disastrous fire could interfere with continuous service.

THE COLUMBUS CITIZENS' TELEPHONE CO., of Columbus, O., which controls the automatic telephone business in that city, has introduced a rather unusual device to assist in maintaining the service at the highest standard. This consists of an Allis-Chalmers portable air compressor, which can readily be moved about the switch room. The switches used in this service are very delicate and if they become laden with dust the service is sometimes interfered with so the portable compressor will be used for supplying air for blowing the dust from the instruments. Too strong a blast is not desirable, as that also might disarrange the switches, so the compressor is set to maintain a pressure of about 45 lb. It is anticipated that this scheme will materially reduce the cost of upkeep.

POWER FROM EXHAUST STEAM

BUILDERS of reciprocating engines long ago realized the fallacy of attempting to work a reciprocating compound engine on vacuums higher than 26 in. Although, theoretically, more power should be obtained by exhausting the reciprocating engine into a 30-in. instead of a 26-in. vacuum, it is found in practice that the large increase in volume of steam due to these low pressures necessitates such large engine cylinders that no gain in economy is experienced by using the high vacuum.

In expanding steam adiabatically through a range of pressure, say, from 150 lb. gage to 28-in. vacuum shows that almost 0.5 of the heat energy which can be converted into useful work is available below atmospheric pressure. It is thus seen that when engines exhaust to atmosphere nearly half of the available energy in the steam is thrown away.



SECTIONS OF AMERICAN REGENERATOR FOR HANDLING EXHAUST STEAM

Reciprocating engines show higher efficiencies working through the higher range of steam pressures, a steam turbine on the other hand shows higher efficiencies when working under low pressure, as from atmospheric pressure down to a 28-in. vacuum.

Steam plants now using reciprocating engines, either condensing or non-condensing, can, in the majority of cases add an exhaust steam turbine to the present equipment and increase the power output from 60 to 100 per cent without further investment in boilers, chimneys, or housings, and since no more live steam is used, the coal consumption will not be increased.

The chief difficulty, however, lies in the fact that the exhaust from the reciprocating engine is intermittent while the steam turbine should have a constant pressure at this first stage. Then again, it is hardly possible to imagine a plant where the load on the steam turbine could be exactly equal to the load on the reciprocating engine. It thus happens that the reciprocating engine, at one moment, discharges a larger volume of steam than the turbine can use, and at the next moment an overload occurring on the turbine, there would not be enough steam exhausted from the reciprocating engine to enable the turbine to meet its load. It will thus be seen that to use a combination of reciprocating engines and steam turbines it is necessary to have some sort of a steam storage arrangement which can absorb the excess exhaust steam of one moment and carry it over to make up the deficiency of the next.

Such storage has been sought by passing the engine exhaust into large receivers or tanks filled with iron or with water in iron trays, but because of the low heat-absorbing capacity of iron, (one-ninth part of water), such receivers have necessarily been tremendously large, heavy and costly for the amount of heat stored.

In the operation of such receivers, when more steam is delivered to the receiver by the engine than is withdrawn by the turbine, the vapor pressure and therefore the vapor temperature rises, whereupon some of the steam gives up its heat to the water in the receiver, causing condensation. Again, when the steam withdrawn by the turbine is greater than the supply of steam given by the engine, the pressure in the receiver falls, and the water which has been heated previously gives up some of its heat, thereby reevaporating a certain amount of water and supplying the deficiency of steam. The amount of heat storage, therefore, is limited by the range of rise and fall in temperature of the heat storing medium. If it is desired to maintain the pressure in the receiver within the limits of 15 lb. to 18 lb. absolute, the temperature range will be from 213 to 222.4 deg. F. and each pound of water heated and cooled throughout this range will store up and release 9.4 B. t. u.

As an improvement over these attempts to use iron trays, the American Regenerator Co., of Chicago, Ill., has recently placed on the market an efficient apparatus known as the American Regenerator for use in connection with a combination reciprocating engine and steam turbine plant.

The standard of perfection for a Regenerator is that the temperature of the water in it shall respond to the entire range of temperature as the steam pressure within the apparatus rises and falls. If the steam be merely blown in above the surface of the water all of the heat will not be absorbed since only the upper layer of water can be heated as the pressure rises. If the steam be blown through the water, better results can be obtained, but not perfect results unless the water be violently and thoroughly circulated.

Referring to the illustration herewith, the water from the larger tank falls through a pipe, containing a valve, into an annular space surrounding the perforated spray pipe through which the exhaust steam from the engine enters at the left. In entering the lower chamber the exhaust steam operates a vane which in turn controls a valve in the pipe connecting the upper and lower chambers, thus the amount of water supplied to the outside of the spray pipe is always proportioned to the amount of exhaust steam passing through it.

In this manner the steam comes into thorough contact with every particle of the water, so that the water is heated up to the full temperature of the exhaust steam. The momentum of the steam is sufficient to carry the mixture of water and steam up through the

eduction pipe into the upper tank where the mixture is delivered against suitable baffles and separated from the steam. Thus it will be seen that the coldest water in the regenerator is intimately mixed with the exhaust steam and returned to the surface of the water, inducing perfect circulation and perfect mixture of water and steam.

Again, the water level in the American Regenerator being at the center of the tank gives a shallow depth of water enabling steam to be readily disengaged during re-evaporation and presenting the maximum surface for the disengagement. It should be borne in mind that the hydraulic head of a body of water influences the speed of evaporation. The increase in temperature required for the liberation of the steam is 1 deg. F. for each 8 in. depth of water.

A further advantage of carrying the level at the center line of the tank is that it gives a greater liberating area which means less tendency toward priming and carrying over of water with the steam to the turbine. It is of the greatest importance that the steam supplied to the low pressure turbine be as dry as possible, not only for the purpose of economy but also to prevent erosion of the turbine blades.

Consider what happens when there is not sufficient exhaust steam to supply the demands of the turbine. If the engine is shut down entirely, the turbine draws steam from the Regenerator and the pressure therein falls. This leads to the re-evaporation of some of the water in the Regenerator, the heat for this evaporation being supplied by the water, which falls in temperature. To supply 1 lb. of steam at 15 lb. absolute pressure requires 965.6 heat units; and if the total range in pressure is from 15 to 18 lb. and from 213 deg. to 222.4 deg. in temperature, each pound of water will restore 9.4 B. t. u. and therefore to supply 965.6 B. t. u. to evaporate 1 lb. of steam, the tank should hold 103 lb. of water for each pound of steam to be supplied to the turbine, during the period of regeneration. The pressure at which the regenerator is operated can be varied to suit requirements but it will usually be found advisable to operate at or above atmospheric pressure in order to forestall air leaks, as air is highly detrimental to the vacuum in the condenser.

Obviously the size of the Regenerator will be determined, not only by the amount of exhaust steam supplied by the engine and by the size of the turbine, but also by the length of the time interval during which the Regenerator must supply steam to the turbine.

In some cases the Regenerator will have to furnish all the steam during certain periods of time, as in the case of reversing rolling mill engines, mine-hoisting engines, steam hammers, etc., which stop altogether. In a large number of plants, however, the supply of steam does not cease entirely but only fluctuates, that is, there are peaks and valleys in the load curve. Supposing that the turbine load is constant and that all the exhaust steam is to be utilized, these peaks must be carried over to fill up the valleys, and the size of the Regenerator will be determined by the magnitude and duration of the load fluctuations.

It is not desirable to provide storage for too long a period, since if the main engines are stopped for any considerable time, the boilers will soon begin to blow off, and it will be as well to use this blow-off steam directly in the turbine, through a reducing valve, or on the high pressure stage of a mixed flow turbine, as to provide sufficient Regenerator capacity to carry the turbine over a longer period of time.

NEW YORK'S NEW MUNICIPAL OFFICE BUILDING

WITHIN a hundred feet of the Brooklyn Bridge Terminal in one of the busiest thoroughfares of New York City an important and interesting engineering work is being undertaken.

As the accompanying photographs indicate, the work on the foundation of the new Municipal Office Building being erected on the triangle bounded by Center and Duane Streets and Park Row, is rapidly progressing, considering the difficult conditions.

This building when completed will be the largest municipal office building in the world, costing over $7,-

FIG. 1 NEW YORK MUNICIPAL OFFICE BUILDING

000,000.00, and housing all of the New York City Departments, excepting the Police, Fire, Docks, Ferries and Health Departments, and will consist of 34 stories, reaching 539 ft. 10 in. high above the curb.

The foundation work which was begun early in the fall of 1909 attracted considerable attention on account of the adoption and development of unusual methods in

engineering practice. The lot contains over 44,000 ft. and is all sand formation. The foundation work involved some difficult caisson work, and 116 caissons are being sunk to reach the solid bed rock, and to hold the enormous weight of the building.

These caissons average in depth 145 ft., the rectangular ones are 5 ft. 6 in. by 11 ft. to 128 by 33 ft., and the cylindrical are 6 ft. 6 in. to 14 ft. 2 in. in diameter, and when completed will contain over 55,000 cu. yd. of concrete, requiring 233,750 bags of cement.

The Foundation Co.'s round, oval and collapsible horseshoe shaft, built in sections, was adopted for sinking the separate caissons, the accompanying illustration showing how the caissons are sunk. The air locks are placed near the surface and furnish entrance to the shafts, and

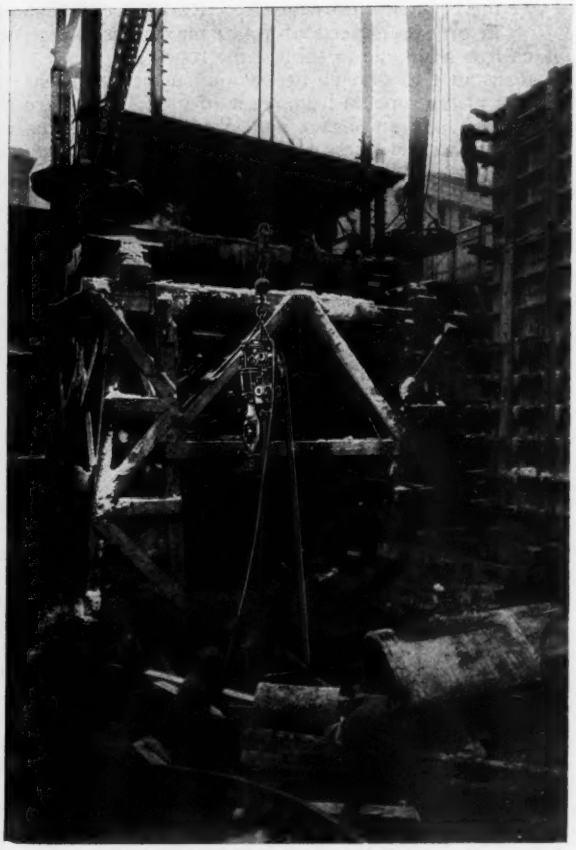


FIG. 2 CAMERON VERTICAL PLUNGER SINKING PUMP

the sectional shafts are bolted together as they descend. When they reach the desired depth, and the concrete foundations are secured on solid bed rock, the iron shafts are removed by the use of the steel derrick as shown in the photograph.

The cellar bottom is within a few inches of tide water level, and on account of this part of the city being almost entirely of sand formation, there is a considerable and constant invasion of water from the East and the North Rivers into these shafts, which has to be pumped into the sewers above, and several large Cameron Vertical Plunger Sinking Pumps were selected for this necessary work and are carrying it on successfully. The photograph illustration shows the manner in which these vertical shaft sinking pumps are suspended from the hook of the derrick in order that they may be lowered into the various shafts at a moment's notice.

That this great undertaking may not be retarded by invading water from heavy rain or melting snow and ice, or even from the leaking water mains, a number of Cameron Station Pumps are situated in various parts of the work, keeping the various workings dry and free from all water. The power is compressed air, supplied by 1 McKiernan and 3 Ingersoll-Rand compressors, with a combined capacity of 18,000 cu. ft. of free air a minute.

The Foundation Co. is the contractor and employs a double shift of men, working continuously day and night. L. L. Brown is the general superintendent, and W. S. Downing is the superintendent in charge of the work.

CUTTING OIL COSTS

OIL is one of the things which seems to disappear mysteriously in a plant. In one case mentioned in Factory a new superintendent found that the oil consumption on the average was a barrel of oil, 50 gal. at 30 cents a gallon, each week, which was about twice as large as it ought to be.

Starting an investigation he found that the holes in the oil can spouts were 4 times as large as needed, that oil casks as delivered were not always full, that checking up was not carefully done, so that some oil which had never been delivered had been paid for and that the oil was stored in an out-of-the-way corner with nobody held responsible for its disappearance. The oils as used were not rightly adapted to their purpose and much power was wasted by having it either too thick or too thin.

Examining the machinery he found some of it oil coated, while some of it showed signs of excessive wear for want of oil. As the plant was too small to put a special man on the oiling proposition, he had tests made to find out which oils were best adapted for the different machines and adopted instead of 2 kinds of oil, which had before been used, 6 kinds and 2 good kinds of grease, a soft grease for slowly moving bearings and a hard grease for rapidly running bearings. The 6 kinds of oil used were cylinder oil, heavy engine oil for engine and other heavy bearings, light spindle oils for the spinning department, dynamo oil for motors, a medium heavy oil for general machinery, and a stainless oil for the looms.

A careful oil record was then started of all oils which came into the plant, when they were received, the inspection of barrels, where they were put in the store house, and what departments the oils should be used in. A man was then placed in charge of the oil house and made responsible for issuing the oils. After careful experiment the amount of oil to be used each week and to whom it should be issued was put in the oil record book. In this way the oiling was brought down to a scientific basis and the oiling itself was done by people of good judgment instead of by haphazard boys. After charging up all cost of the new system and the labor on the oil account, it was found that a saving of $300 a year had been made.

A TESTING PAPER for finding the polarity of weak currents may be made by saturating a piece of blotting paper with potassium iodide and a little starch paste. With the paper slightly damp, place the terminals of the battery so that they are separated by the testing paper. A blue stain will appear at the anode or wire connected to the positive pole.—Popular Electricity.

HONEST THINKING must precede honest doing. If you would practice honesty with others, which is the only safe policy, be absolutely honest with yourself.

DIRECT READINGS FROM A SLIDE RULE

THOSE who are familiar with the use of the slide rule will appreciate without any emphasis on our part the convenience of the improved form devised by Geo. W. Richardson, of Chicago. Those who regard the slide rule as a mystery will be pleasantly surprised by the simple explanation of it given in the pamphlet which accompanies this rule.

As a matter of actual using it makes no difference whether you understand how a slide rule does it or not. It can be operated and results obtained just the same, whether you understand anything about logarithms and exponents or whether you don't. This improved form is designed to make the rule as nearly automatic as possible.

Use of the ordinary slide rule for multiplication, for instance, consists in setting division 1 of the C scale, shown on the illustration, to the first of the numbers to be multiplied and finding on the C scale the second number when the product of the 2 will be found on the D scale opposite that number. The operation is the same as laying off a measurement of 7¼ in. and on the end of that laying off 3⅛ in. then measuring the whole distance to find what the sum of the 2 is, and the operation of using the slide rule is no more complicated than the operation of addition just described.

SEE THAT HOLE
GEO. W. RICHARDSON'S DIRECT READING SLIDE RULE
PATENT APPLIED FOR
ADDRESS 4212, 64TH PLACE, CHICAGO, ILL.
SEE THAT HOLE

THE RICHARDSON DIRECT-READING SLIDE RULE

Certain conversions, as, for instance, the number of cubic inches in a given number of gallons, or the number of inches in so many meters, or the number of horsepower that would be represented by a given number of British thermal units expended per minute, are frequent in engineering problems, but involve, when you do them with figures, considerable multiplication and gray matter to be sure that you have made your multiplications right side up.

By a series of key letters, the Richardson rule, shows exactly how to set the rule to get these conversions without any thought on the part of the operator. The line through the key letter is set opposite the line in the key hole shown on the illustration, and the conversion of any number of gallons into its equivalent cubic inches or any number of pounds evaporation from and at 212 to standard boiler horsepower, as the case may be, can be found by a single inspection.

Mechanical improvements are the use of aluminum for the base and runner, so that no warping can take place, the use of flat celluloid scales which makes the device tight and compact, the use of a glass runner with double guide marks permitting easy reading close to either end of the rule.

Another improvement is that the rule is sold at a small cost as compared with the older types, the price being $2. With the rule goes a book explaining how to use it, both how to use the direct reading scales, this explanation being also shown on the rule itself, and as well how to square or cube a number, how to extract square or cube root, how to work proportions, how to combine multiplication and division in a single operation, the method of finding the horsepower of an engine, the size of motor to run a pump, horsepower of a waterfall, horsepower of double and single belting, diameter of steam mains, diameter and speed of pulleys, size of duct for ventilation and other engine room calculations.

It is a device which those having engine room calculations to perform will find a great time and brain saver.

HORSEPOWER OF MANILA TRANSMISSION ROPE

POWER which may be transmitted by a rope is dependent upon the following factors, according to the Plymouth Cordage Co.: Resistance to slipping in grooves; speed of rope; maximum tension to which it is advisable to subject the rope.

Resistance to slipping depends upon the coefficient of friction of the rope on iron, angle of groove used, arc of contact of rope on sheave and size of sheave, taken in connection with stiffness of rope. The matter is summed up in a general way by taking the ratio of tensions between slack and driving sides of rope as 1 to 2, which is the common rule to cover well lubricated ropes, and least arc of contact of 165 deg.

Speed of a rope adds to its carrying power directly in proportion to its increase; but the centrifugal force adds tension as the square of the speed. It therefore follows that a certain speed will be reached, which, if exceeded, will add more tension from centrifugal force than can be gained in carrying power. The tension from centrifugal force is found by multiplying the square of the rope speed in feet per second by the weight of 1 ft. of rope, and dividing by 32.

Maximum tension which it is advisable to put on a rope is taken as 200 times the diameter squared of the rope. This is a common rule arrived at by careful comparisons of different economical and satisfactory rope drives. While in many places this rule is exceeded without apparent harm, yet it is a reliable foundation to start from in figuring drives and should be exceeded only after careful consideration.

Let us now work out a sample drive with our factors as before given. Required, for example, to find the horsepower of a 2-in. diameter rope, running 4200 ft. a minute. One foot of this rope will weigh 0.336 times the diameter squared equals 1.34 lb. Multiply by 4900, which is the square of the velocity in feet per second, equals 6566, and divided by 32 equals 205 lb., which is the tension from centrifugal force. The maximum allowable tension equals 200 times the diameter squared: 200×4=800 lb.; 800—205=595 lb. A part of this is balanced by the initial tension necessary to stop the rope from slipping in the groove, which part we have decided to be in the ratio of 1 to 2. Multiply 595 by 2 and divide by 3, and the result is 396 lb. to be utilized in work. Multiply by 4200 ft. a minute and divide by 33,000=50, nearly; that is, a 2-in. diameter rope, running at 4200 ft. a minute, angle of grooves 45 deg., least arc of contact 165 deg., fair proportion centers, would do 50 hp.

COST OF POWER

IN an interesting discussion of the general principles governing the cost of power F. W. Dean says that it is made up of the following items: Interest, say at 5 per cent; taxes, ½ per cent; insurance, ½ per cent; repairs, 2 per cent; depreciation, say at 4 per cent; total fixed charges, 12 per cent. Cost of attendance and administration, cost of fuel, cost of water, cost of oil, waste and supplies.

Often the cost of power can be estimated at much less than this, as, for example, when an addition has to be made and it is necessary to compare additional costs with the cost of purchased electrical power. In a certain case a mill had a boiler plant and an engine, the boiler plant being rather more than sufficient for the original work, so that no more boiler power was required for the new work. The attendance in the boiler room would not be increased by the addition. In this case the additional cost for power would not be made up of any fixed charges on the boiler plant nor of attendance in the boiler room. It would consist of the charges on a new turbine installation, the attendance on the turbine, which would require a new man at least a part of the time, and the cost of additional coal. The local electric company offered to sell power at 1.1 cents per kilowatt-hour at the switchboard. It was found that the additional cost of electrical power made at the mill was considerably less than 1.1 cents, being in fact 0.8 cent.

In another case a company was paying $24 per hp. per year at the switchboard. The outside power was made by a waterpower plant which failed in dry times. Furthermore it could not spare sufficient power in the winter at the late hours of the afternoon because it had to light the town. The consequence was the company had to maintain a steam plant of sufficient capacity to operate the plant, with the requisite attendance. The rate $24 a year seemed low and a long time contract was made with the power company. The cost of power to the plant was made up of the following: Fixed charges on their own steam plant; attendance part of the time; coal used part of the time; oil, waste, and supplies part of the time; cost of purchased power at $24 per hp.-yr.; total cost of power to the company, $33 per hp.-yr.

If they had made all of their power by the most economical plant it would have cost about $18 per horsepower yr., especially as they are obliged to use steam for other purposes and could therefore charge some of the fixed charges and attendance of the boiler plant to these purposes.

In another case a company was offered water at $10 per gross horsepower per year, the dam and canal having been built by the company controlling the water. The purchasing company would have to build the remainder of the waterpower plant. The advisable waterpower development was about 1400 hp., this being the power between the 8th and 9th months in the order of dryness. The minimum power was 245 hp., both of these powers being for average years. In unusually dry years, which come along occasionally, there would be no waterpower. The consequence would be that there would have to be a steam plant as large as if there were no waterpower. There would be no steam power required, theoretically, 4 mo. in the average year, but the attendance probably would be required all the time, because in the winter anchor ice, or an exceptionally dry winter might make it necessary to operate the steam plant at any time during these 4 mo. In consideration of these matters the cost of power would be great because 2 large plants would have to be maintained. The final outcome would be about as follows, with and without the hydro-electric plant:

ANNUAL COSTS OF OPERATION

	Hydro-Electric Plant and Steam Plant	Steam Plant
Fixed charges	$19,600	$13,000
Cost of attendance	4,880	3,780
Cost of water	9,710	00
Cost of coal	8,455	21,948
Cost of oil, waste and supplies	467	280
	$43,112	$39,008

Difference in favor of single steam plant, $4,104.

If this had been in some parts of New England where coal costs $5 a gross ton the combined plant would have saved about $11,000 a year. The proposed plant was to be in a locality where coal costs $2.95 a gross ton in front of the boilers.

This is a fair illustration of the extra expense which the development of a waterpower may cause. In most cases waterpower fails in dry weather to such an extent that a full power steam plant will be required. In many of the very large developments this is not so. In such cases the economy of water power is manifest on account of the low cost of maintenance and attendance, and the absence of fuel cost. In cases where a waterpower fails to such an extent as to render a full power steam plant necessary, if the cost of coal is high the waterpower is likely to pay, but if the cost of coal is low it is not likely to pay. There are many cases where waterpower was developed many years ago when steam engines were wasteful and gas engines were unknown, but if the developments had not already been made they would not be made now.

PURE WATER USED

AS A statement made in the article in the June issue in regard to the plant of the Corn Products Refining Co. at Argo, Ill., is liable to a possible misapprehension, we wish to correct any error that may arise on this account.

While the water for feeding the boilers is taken from the Drainage Canal, all water for use in the manufacturing processes of the plant is taken from artesian wells. In case of emergency the artesian well water may be used for feeding the boilers, but the canal water is never used for any purposes in the plant except for boiler feeding. The greatest care is used in all the manufacturing processes to keep the products absolutely pure and free from any contamination.

The water from these artesian wells, which is obtainable in such large quantities, is claimed to be of the purest quality and most helpful in enabling the company to produce the highest quality of food products. It is claimed that this abundant supply of this extremely pure water is one of the great advantages and the reason for locating the works at Argo.

EXPERIMENTS HAVE BEEN MADE to show that the temperature of a magnet has something to do with its power to attract and hold. By placing a magnet in alcohol Mr. Pictet found that if the unit 57 measured the pull at +30 deg. C, the attraction when the temperature was at —103 deg. C was 76, thus showing a decided increase in power at a low temperature.—Popular Electricity.

THE OILER'S SUGGESTION is as good as the manager's if it helps along the work.

Letters From Engineers

Tell us about your new kinks and new thinks. Rough sketches are always helpful; we make the drawings. Cash paid for accepted contributions.

CYLINDER LUBRICATING SCHEMES

WHILE visiting in a small town in a nearby state, I ran across the following piece of apparatus which seemed to be working very satisfactory, with a saving of cylinder oil. It also proves to be a time-saver as well, as the ordinary cylinder oil lubricator needs to be filled every 4 or 5 hr. There are times when the engineer is busy with a break down or is called away, in which case the lubricator runs dry and the cylinder goes without oil, which is not the best thing for the wearing parts inside of the cylinder.

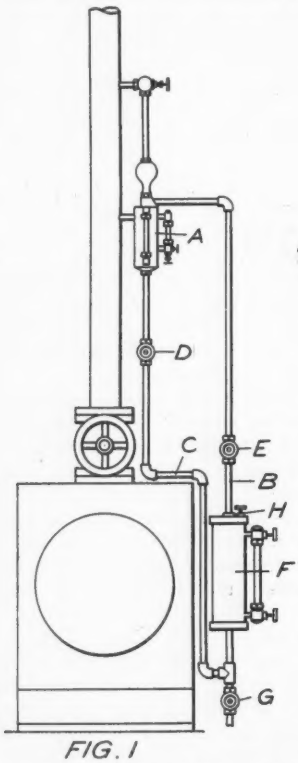


FIG. 1

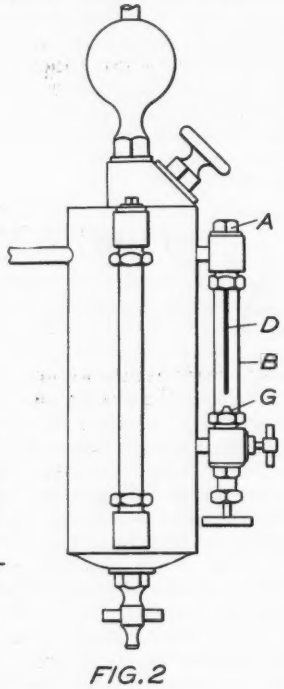


FIG. 2

FIG. 1. RESERVOIR ATTACHMENT FOR LUBRICATOR
FIG. 2. SCHEME TO DIRECT THE CYLINDER OIL

With this apparatus there is not this danger as it would require filling only every 3 or 4 days.

This also has the advantage in that we do away with the cylinder oil can sitting on the cylinder, it generally leaks and makes a dirty looking cylinder, which is an eye sore to every engineer who has any respect for himself.

This apparatus may be connected to your present lubricator with very little trouble. It consists of a piece of 6-in. pipe, F, 12 in. long, capped at both ends. This reservoir, F, is connected to the lubricator, A, by the 2 ¼ in. pipes B and C. The operation is precisely the same as with the ordinary lubricator; the oil flows from the reservoir to the lubricator through the pipe B, which is taped into the top part of the lubricator A. As the oil flows from the lubricator its space is occupied by condensed steam which flows to the reservoir through the pipe C. In this manner the lubricator A is always full and thus a continuous flow of oil to the cylinder is maintained.

In order to fill the reservoir, the valves E and D are closed, the water is then drained from F through the valve G. Oil is then supplied through the valve H. The reservoir F being placed close to the cylinder will keep the oil warm at all times.

Another annoying feature of the hydrostatic lubricator is the clogging up of the feed glass or its becoming dirty, so that the amount of oil fed to the engine is hard to determine. There are several ways in which this may be avoided temporarily, 2 of which, in most general use, are: first, to fill feed glass with a solution of salt and water; second, by using glycerine in the glass. Both of these solutions in time will become weak and run off with the oil into the cylinder, leaving the lubricator in no better condition than before.

A short time ago we began using a heavy oil with the result that it was practically impossible to keep the feed glass clear, so I tried the following scheme which has given good results so far:

The plug A on top of the feed glass B was removed and a small piece of copper wire about 1-64 inch in diameter was soldered on the bottom side. The wire was cut to the proper length so that when plug was in place the bottom end of the wire was about ¼ inch from the nozzle C. The result was that as the drop left the nozzle C, it came in contact with the wire D, instead of the glass, which conveyed the oil to the top, thence to the steam pipe in the usual manner, leaving the glass clean and free from dirty oil.

E. S. Libby

SHRINKAGE OF WATER

SINCE reading Harry W. Brenton's article in the May, 1910, issue of Practical Engineer, concerning the question "How Did the Water Get Out of the Boilers," or "Where Did that Water Go," as asked by one of your readers and as was published in the January, 1910, number of your paper, I thought that I would like to take a shot at an answer with the others who have responded. To begin with, I will say that not any water escaped or got out of the boiler and that all the water that was in the boiler when it was shut down was still there the next morning.

Water responds under the influence or action of heat, i. e., it increases in volume. Then when it cools it contracts or decreases in volume, as was done or brought about by the boiler standing all night without

sufficient fire under it to keep it hot. Where I am employed, we have a battery of boilers of the water-tube type, each of which is 34 in. diameter by 18 ft. long, and there is never any water found in the gage glass or gage cocks in the morning, although 2 gages of water is always on hand when we stop for the night. Besides we never place more water in the boilers in the morning than that required to bring the water up about half way in the gage glass. If more than this is put in when it gets hot it will flow over to the engine by way of the steam main from which it would have to be removed before we started the engine going.

We do not have any trouble with priming, hardly know what it is, save for what we read about it. If the engineer in charge of this mysterious boiler, will determine as to just how many cubic feet of water his boiler contains at night when he shuts down, and will also note the pressure, and then look at a steam table and find the temperature of the water which is in the boiler, at the pressure indicated by the steam gage, and refer to table which shows the increase in volume of water under the action of heat of different intensities, and multiply the difference between the volumes of equal weights at different temperatures, he will soon see that his boilers did not give up any water.

He should take the difference between the volume of 62.5 lb. of water at the temperature of the water in the boilers at night, and the volume at the temperature of the water in the morning, and multiply this by the total volume in cubic feet of water that his boilers contained at night, and subtract the product from the total volume in cubic feet that he had at night, the result will be volume of water contained by the boiler in the morning which will more than likely check with the observed results. T. C. R.

VACUUM CLEANING FOR ELECTRICAL EQUIPMENT

COMMON garden hose attached to an independent condensor in the power station, is a fine extractor of dirt from the inside of an armature or other electrical apparatus, where it is undesirable to raise dust. The hose should be void of any metallic substance on the end applied to the armature. The most desirable time to apply this cleaner is when the engines are off.

Geo. T. Everill.

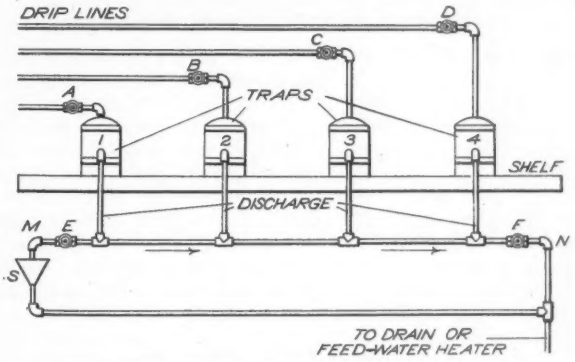
A NOVEL ARRANGEMENT OF STEAM TRAPS

WHEN a system of steam piping is installed, traps are placed at what are considered the necessary points. The traps are new and, if adjusted properly, will remove the water of condensation. They will not continue to do so, however, unless given some attention for, like all other mechanical apparatus, they must be humored.

Steam traps are, as a rule, placed in the most inaccessible places in the power house, the idea being to get them out of the way. They are out of the way and, consequently, are overlooked by the average engineer. From my experience I have found that, in 7 cases out of every 10, the trap is not working properly.

Suppose all of the traps were grouped together and the piping so arranged that they might be tested individually, would they not receive more attention? The arrangement shown in the diagram was gotten up with this idea in view.

The drip lines are lead to the traps in the customary manner, the discharge lines from the traps, however, are all brought to the one header which has been lettered MN. When all of the traps are in operation valves A, B, C, D and F are open and valve E is closed. This allows the discharge from the traps to take the direction of the arrows, flowing to the drain or feed-water heater. Suppose valve F is closed and valve E opened. The direction of flow in the header is now reversed and is from N to M. Flowing, as it does, from the open pipe into funnel at S the discharge is plainly visible. If we wish to see, then, how any one trap is behaving we have but to



CONVENIENT ARRANGEMENT OF TRAPS IN A GROUP

close all the inlet valves to the traps except to the one in question, close valve F, open valve E, and watch for the discharge at S.

The drip lines are lead to the traps in the customary manner, the discharge lines from the traps, however, are all brought to the one header, which has been lettered MN. When all of the traps are in operation valves A, B, C and D are open. H. H. L.

DIAGRAMS FROM HAMILTON CORLISS ENGINE

DIAGRAMS from a Hamilton Corliss engine, on page 435 of July number, when traced with a planimeter give m.e.p. of 37.5 for head end and 38 for crank end. The engine constant for head end is $2.5\times14\times14\times0.7854\times90\div33000=1.049$. Allowing for a 2-in. piston rod the crank end constant will be 1.028. This gives as horsepower for the head end $37.5\times1.049=39.33$; and for crank end $38\times1.028=39.06$. Total 78.4 hp.

The wavy expansion lines may be caused by whipping of indicator cord, too much pressure upon the pencil, or friction in the indicator parts. The line is not bad. The value setting looks very good. The steam lines are not horizontal, but this fault may have crept in in tracing or it may have been caused by too much pressure on the pencil. It is barely possible the compression might be decreased a little without interfering with smooth running. William E. Dixon.

A HOISTING ENGINEER'S DUTY

FIRSTLY, he should be a reliable man. One in whom you can place confidence, especially when handling men.

Secondly, he should, before taking his shift, look over his engine, particularly brakes and friction, and he will then be able to give his full attention to handling his engine.

Thirdly, and lastly, he should allow no person to talk to him either while hoisting or waiting for the signal to begin again, as it takes his attention, which is needed on his bells and reversing levers, from his

work; and it also takes his attention from the points "where he is hoisting from" and "where he is stopping," and at the same time he has to watch his flash-light call system and answer his telephone underground system and keep his eye on his engine.

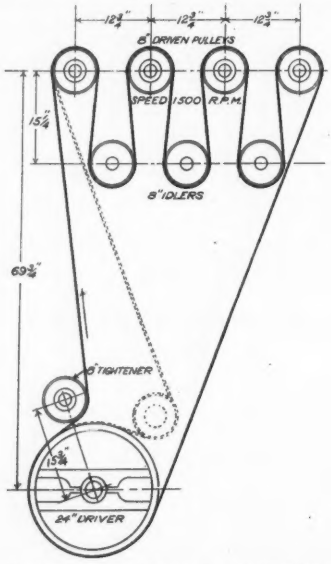
This is why he should work only 8-hr. shift, as it needs such close attention. It is, however, nice work for those adapted to it, and one becomes attached to it. He should not be bothered with the boilers but must be able to handle them to hold his license.

W. T. Trembath.

BELT FOR MULTIPLE DRIVE

MY first experience with a drive of the kind shown in the cut was on a special machine that I designed. The belt had to transmit 35 hp. on the average. The driver was 24 in. in diameter and all of the other pulleys were 8 in. in diameter. The driven pulleys were all straight face, and the idealer pulleys were all crown face. The speed of the driven pulleys was 1500 r. p. m.

The first belt that I applied to this drive was the best double leather belt that could be purchased and I am sorry to say that it went to pieces in about 12 days. Then I purchased a heavy single leather belt. This belt was



ARRANGEMENT OF PULLEYS IN MULTIPLE DRIVE

made of strictly center stock and of a uniform thickness and standard laps. This belt gave better satisfaction and it lasted about 2½ months. After I examined this belt thoroughly I discovered that the belt was cracked all to pieces from both sides.

Then I ordered another belt to be made of strictly center stock and to be of uniform thickness of 5/32 in. The laps to be made long enough to cover one-half of the circumference of the driven pulley. When I received this belt I had it thoroughly stretched, and then I had our pattern maker plane it down on the flesh side so that it was perfectly uniform in thickness. After this was done I had the belt scraped, or buffed as people call it, on the grain side.

I applied this belt to the above mentioned drive on March 16, 1907, and I am proud to say that this belt has been running 10 hr. a day ever since, is as perfect as the day it was put on the drive, and has no signs of cracking or giving out in the laps.

I failed to say that the driven pulleys oscilate ¾ in. 60 times per minute. I discovered from the first 2 belts that the laps were too short and the entire lap had to bend one way over the driven pulley and the opposite way over the idler pulley, thus breaking the belt at the end of the laps. By lengthening the laps so that it begins to leave the pulley before the other end begins to get on to the pulley I overcame this trouble of the belt at the end of the laps. The reason for buffing the belt was to overcome cracking on the grain side.

By examining the first 2 belts that I applied to this drive I noticed that they began to crack from the grain side and cracked to the depth of about 1/64 in. then stopped cracking. I made up my mind that if the belt was scraped or buffed on the grain side to this amount, 1/64 in., that the belt would not have a chance to start cracking.

I also failed to state that the width of the double leather belt was 8 in. and the single belt was 9 in. and the present belt is 9 in. This is a remarkable service for a 9-in. leather belt of a thickness of 5/32 in., transmitting 35 hp. at the speed of 5790 ft. per minute.

Julius Hamacheck.

A HOME MADE SEPARATOR

FIGURE 1 illustrates a steampipe and throttle valve of the high-pressure cylinder of a compound pumping engine. There was no separator on this line, and we sometimes had trouble with wet steam. A piece of ¼-in. sheet iron was made as shown in Fig. 2, and

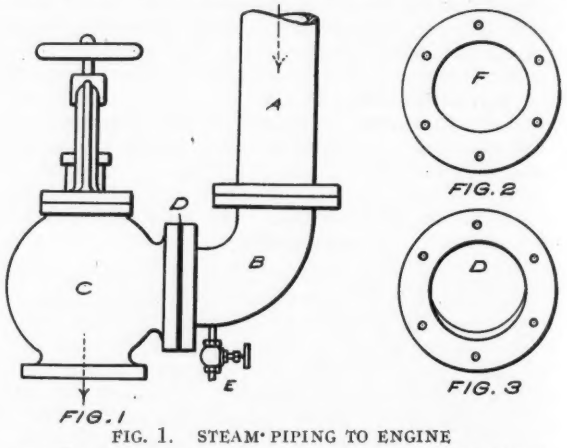


FIG. 1. STEAM PIPING TO ENGINE
FIG. 2. SHEET-IRON DISK PLACED IN FLANGE JOINT
FIG. 3 CROSS SECTION OF JOINT SHOWING WATER SHIELD

placed between the throttle-valve flange and flange of elbow B. Fig. 3 shows a cross section of the joint.

Rubber gaskets were of course placed on each side of the plate. Elbow B was drilled and tapped and pipe E leads to the steam jacket, thence to a trap. The water in the steam collects in the pocket formed by the iron plate and is carried away. The engine runs better, and uses drier steam.

E. G. H.

LUBRICATION; NOISY GEARS; VALVE ADJUSTMENT

I OFFER the following in answer to some of the questions which appear on page 259 of the April issue of your paper.

Replying to E. W., I would say that any of these used with oil will be found of value in keeping down any tendency to heating of bearings and journals, viz., flake graphite, flour of sulphur, powdered soapstone, and powdered mica.

I would try first the graphite; mix a little with the lubricating oil and apply to the troublesome part or

parts, and note results. Unless the parts are out of line, or not sufficient in bearing area, the oil and graphite will give satisfactory results. Flour of sulphur in oil has also proved its usefulness in cooling a hot bearing. In any case any of these remedies must be applied before the heat gains in extent so that even a flood of water cannot carry off the heat fast enough, and the engine must be shut down. Let E. W. experiment with the materials referred to and he will soon find out which is most suitable for his particular case.

In relation to G. W. D.'s pump gearing trouble, I would suggest that he apply some heavy bodied grease or oil to the teeth of the pinion and gear, until he can either remedy the root of the trouble itself or provide new gears. There used to be an excellent material in the market for such gears, named "Ironsides gear shield," made and sold by the Ironside Co. of Columbus, Ohio. I used this material for many years on large cable gears and cannot speak too highly of it as a producer of quiet and smooth running wheels. No doubt this gear shield would be suitable for such a case as cited by G. W. D., if it can still be procured. It is a semi liquid and may be applied warm, while the gears are revolving. It not only makes an elastic cushion for the teeth of the gears to act against, but it clings tenaciously to the teeth for a long time, when, of course, it requires to be renewed by an additional application.

Replying to Lac, would say that the diagrams show the exhaust valves do not open quite early enough to give the best results. The compression is not bad but I think it could be reduced a little and a slight saving in steam consumption effected thereby. The crank end diagram is better than the head end one.

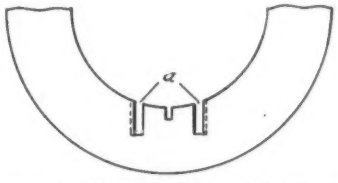
It looks as if the main alterations can be made by readjusting the valve openings and closings through the right and left threaded rods which connect the valve rocker arms to the wristplate. After these 4 rods are changed in length to give the proper opening and closing of the exhaust valves, and the correct opening of the steam valves, it may perhaps be found necessary to advance the eccentric on the shaft by a small amount. Try to produce both head and crank end diagrams like that shown for the crank end in the illustration, with the exception that the exhaust end of the figure should not tend to curl up from the atmospheric line. The back pressure line should be parallel to the atmospheric line for nearly its entire length. Charles J. Mason.

METHOD OF KEYING FLYWHEELS

ONE of the leading builders of Corliss engines, some years ago adapted the following method of keying flywheels which has been used with excellent results. After the keyway in the shaft has been milled the key is planed and fitted singly to the keyway, driven down with a soft hammer, and lines scribed on the side, with a scratch-awl showing the depth when the key is removed. All keys are planed straight with no taper or gib to them, and the fit is made sideways in both shaft and wheel. After the key is removed from the shaft one-half of the wheel is placed on the shaft and lines scribed on the hub, indicating the position of the keyway. The bore of the hub is a few thousandths of an inch smaller than the shaft, the amount of course depending on the diameter. The object of this is to insure a tight fit on the shaft after the wheel is bolted together.

The half wheel is then removed and turned over to be in position for the keyway to be cut, which is done by hammer and chisel. The key is laid in the bore of the wheel and set to the lines scribed on the sides of the hub, and guide lines are drawn beside the key for the chisel to follow. A cape chisel is first used to cut down to the required depth, which is such as to give a clearance of 1-32 in. between the key and the bottom of the keyway when the keyway is bolted in place. The groove a is a little narrower than the keyway, leaving just stock enough on each side to finish up.

A third groove is cut down a little 'way, in case of a wide keyway, and then the metal is cut out



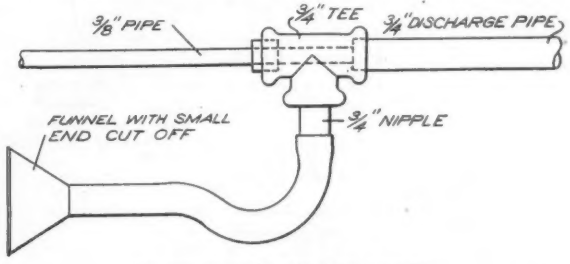
KEYWAY IN FLYWHEEL SHOWING METHOD OF CHISELING

with a flat chisel. The keyway is then filed, care being taken to follow the lines on the sides of the hub. After the key has been driven down it is compared with the lines and if care has been taken will be found reasonably true. The key is then placed in the shaft and the wheel set down on it before it leaves the shop so as to make sure of a good fit. Side of hub, end of key and end of keyway are all marked on same side, so the erector will have no difficulty when placing wheel together. The clearance between the key and the bottom of the keyway in the wheel eliminates trouble of the key throwing the wheel out of true; as is often the case with the taper keys. Tom Jones.

VACUUM CLEANER TO REMOVE SOOT

I HAD occasion to clean the soot off the top of a battery of boilers and made the vacuum cleaner shown in the illustration which did the work nicely without getting soot all over everything.

The cleaner was made by connecting a ⅜-in. pipe from the steam line to a ¾-in. tee which connects as shown to a discharge pipe to the sewer, or other



VACUUM CLEANER FOR BOILER

convenient place, and a steam hose upon which a funnel attached. Use good stiff hose without kinks, and carry the funnel over the soot which will be sucked into the hose and discharged into the sewer. It does not require much steam and will clean the boilers off thoroughly. Chas. Jackson.

ENGINE ACCIDENT AND REPAIR

AT the plant where I am employed we have a 14 by 36-in. Corliss engine running at 85 r. p. m. This is an old style Bates engine, having been in service about 17 yr. and for the past 8 yr. has been run under 125 to 140-lb. pressure, and at times much overloaded. On June 12 we had an accident to our piston rod, where it

connects to the crosshead neck, breaking the rod where the wedge passes through it on the taper end, the rod being of the taper and wedge type.

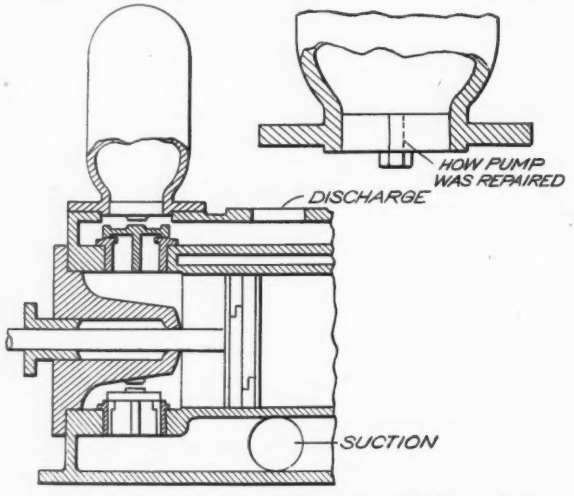
This accident nearly cost the writer his life, as he had stood about 8 ft. from the cylinder head in a direct line with it and then stepped up just back of the head to adjust the lubricator, about 2 minutes before the crash came. The rod broke and the piston went out carrying the head, cover and studs with it. The piston and rings were broken, the head was broken into 11 pieces, the false cover into 6, and 8 of the 10 by ⅞in. stud bolts were pulled in two and the other stripped from the cylinder casting. I was asked to furnish measurements and data to have a new rod and piston made at a machine shop. After some study I concluded to do away with the taper and wedge connection in the crosshead neck, and instead have the rod made long enough to go clear through the neck. Then the taper would be turned out of the crosshead to correspond with the size of rod, and the crosshead and rod threaded, allowing the use of a heavy jam nut to keep the rod from turning when in place. The parts were boxed and shipped at once and accompanied with proper data and instructions. Consequently we have a first-class job and it is highly endorsed by the machinist and our manager. The taper and wedge construction is not suitable for pressures above 100 lb., in my opinion, as the parts are so much reduced in cross section that they are too much weakened to withstand the strains that a rod and crosshead are subjected to.

There is no doubt the threaded rod and crosshead are much superior to the old taper and wedge or it would not be so extensively used in the higher grade engines. I would like to hear from other readers of Practical Engineer on this subject and their experience.

E. C. B.

PUMP VALVE TROUBLE AND REMEDY

SOME time ago I erected an ice-making plant in the West Indies, where I had to use a double-acting piston pump, as shown in the sketch, for circulating cooling water over the steam and ammonia condensers.



VALVE ARRANGEMENT WHICH GAVE TROUBLE AND REMEDY EMPLOYED

Everything worked all right at the start, but after a few months the pump began to give trouble.

The pump is fitted with air chambers of ample capacity on both suction and delivery pipes. The suction pipe is 3 in. in diameter and 175 ft. long with 4 bends, and the discharge pipe 2½ in. in diameter and 25 ft. long, also with 4 bends, the total lift at the pump being 27 ft.

The valves worked very hard and noisy, and at about 1-3 stroke the piston would stop, causing the belt to slip off the pulleys or even break, which seemed to indicate that there was some obstruction to the flow of water in the delivery pipe.

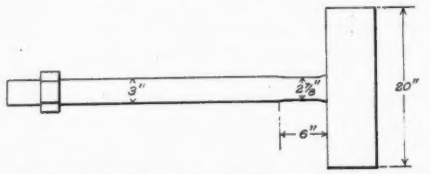
By taking off the 2 air chambers on the discharge side, I noticed that the stop on the valves and in the mouth of the air vessels was worn so that the valves during the delivery would close the entrance to the air chambers, thus putting them out of commission. The piston was then called upon to force the contents of the water in the discharge pipe, which proved too much for the belt.

After putting in 2 ½-in. screws in the crosspiece in the air chambers to reduce the lift of the valves and prevent them from closing the entrance, the pump worked all right again and it has given satisfaction ever since.

Oscar S. Bolling.

TROUBLE WITH METALLIC PACKING

CAST-IRON metallic packing is used on the piston rod of the 20 by 20-in. McEwen engine which runs at 200 r.p.m. in the power house where I am employed. The packing got to leaking quite badly so I pulled it out and as it appeared in good shape I calipered the rod and it proved to be the same diameter at all points outside the cylinder. Upon taking



PISTON ROD WORN BY METALIC PACKING

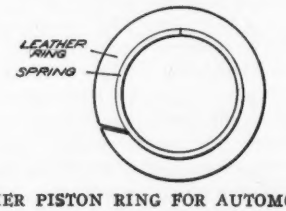
the piston out, however, I found that a shoulder had been worn near the piston as shown in the illustration.

The cause of this uneven wear I contribute to the fact that the worn part of the rod which does not get outside the stuffing box gets it lubrication only from the oil in the cylinder while the rest of the rod gets, in addition, oil from the cup above the rod just outside the cylinder and the splash from the crosshead. I would like to know the opinion of other engineers on this question.

B. Van Toll.

LEATHER PISTON RINGS

SOME time ago an automobile came along the plank road on which I live and met with a bad accident. The owner had the good luck to break 2 piston rings because the intake valve disk broke and smashed up



LEATHER PISTON RING FOR AUTOMOBILE ENGINE

the rest. He was fortunate enough to have another valve with him, but no piston rings, consequently he could not get enough compression to start up the machine, and as people in the neighborhood knew I was an engineer, I was called upon.

I had no rings, but decided to put in leather rings in the manner shown in the sketch. The spring was made of 1-64-in. metal placed under the leather ring, causing this to expand. I advised the owner to oil freely, and he started off with the machine, which was both water and air cooled, with the intention of having it repaired in Milwaukee, 4 miles away. Several days ago I received a letter from him stating that his car was in the garage at his home in Waukesha. He stated that the machine worked so well that he did not think of having it repaired in Milwaukee but kept on until he reached home a distance of 28 miles. The leather rings were somewhat burned but were tight enough in the grooves to hold compression.

Friebert Driest.

IMPOSSIBLE SUCTION LIFT

ON page 197, Silas F. Cronk explained how he rigged up a pump governor; the governor appears to be giving him every satisfaction, but he states that the normal suction lift is 30 ft. and that it varies between this amount and, say 40 to 45 ft. and that before using the governor he constructed, the lift frequently was 50 ft. Since the suction pipe is only 50 ft. long, it is plain as he states that when the surface of the water in the well gets down to the end of the pipe, the pump must lose its water. His governor has overcome this trouble.

It would appear from the manner of his statements that he does not think 30 to 50 ft. lift out of the ordinary practice or beyond practical operation, and one would naturally think from the manner of his language that if that suction pipe were 10 ft. longer, making the suction pipe extend down into the well 60 ft. instead of only 50 ft., that our friend would expect the pump to keep right at work.

Water is forced up the suction pipe of any pump by the pressure of the atmosphere exerted upon the surface of the water outside of the suction pipe; the action of the pump expells a part of the air inside the suction pipe thus reducing the atmospheric pressure inside the suction pipe, so that the pressure outside the suction pipe is greater than the pressure inside the suction pipe; hence a quantity of water is forced up the suction pipe until the weight of this column of water plus the pressure exerted upon its surface just balances the pressure of the atmosphere on the surface of the water outside of the suction pipe, thus if it were possible for the pump perfectly to eliminate all atmospheric pressure from within the suction pipe, the column of water in the suction pipe would have to be high enough to produce a pressure at its base equal to the pressure of the atmospheric pressure outside the pipe.

The atmospheric pressure at sea level is 14.7 lb. per square inch, and so far as steam power plant pumps are concerned it is impossible to pump all of this pressure from any closed vessel or pipe. Vacuums of 29.5 in. of mercury are secured with some types of condensing apparatus but it is not common. A vacuum of 29.5 in. represents an absolute pressure of $14.7 \div 30 \times 29.5 = 14.455$, thus $14.7 - 14.455 = 0.245$ lb. pressure absolute per square inch still remains in the system. Suppose that at sea level we can entirely eliminate all pressure from a vertical pipe so that the pressure inside is absolute zero of pressure that no friction of any kind exists so that the full pressure of 14.7 lb. per square inch is available to force a column of water up the pipe, then the height of that column of water will be $14.7 \div 0.434 = 33.87$ ft. high. Even at sea level so far as steam engineering is concerned, it is impossible to life water by suction even 33 ft., and in actual practice about 28 ft. is considered about the greatest suction lift that can be obtained with any satisfaction.

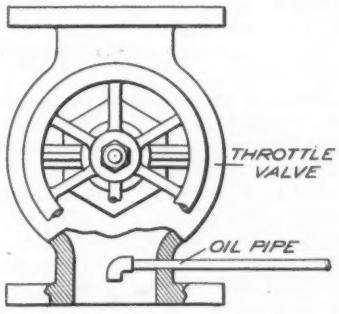
Just how Brother Silas can work a suction lift of from 30 to 50 ft. is a bit of knowledge all Practical Engineer readers would like to obtain.

Harry W. Benton.

OILING CORLISS VALVES

SOME time ago I took charge of an engine of which the valves and cylinder were lubricated by an oil pump. If I reduced the amount of oil below a certain quantity the steam valve nearest the oil supply would work all right, but the other would grunt and groan.

On disconnecting I found the oil pipe ending with a nipple extending just through the wall of the lower



OIL PIPE TO CYLINDER VALVES

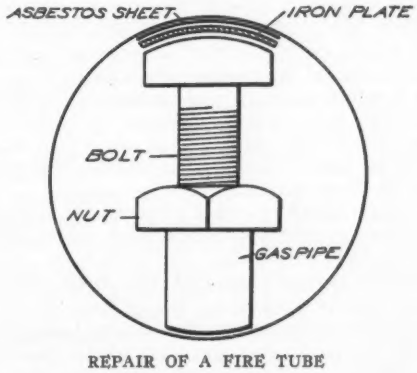
part of the throttle valve and it seemed reasonable to suppose that the oil was never carried along with the steam but clung to the walls of the steam chest and followed to the nearest valve.

To remedy this I fitted a short piece of ⅛-in. pipe with an ell and pointed the end downward, as the sketch indicates. This has overcome the difficulty and both valves take the needed amount of oil.

Henry Simonson.

REPAIR FOR FIRE TUBE BOILER

THE sketch shown here illustrates how a leak in a 6-in. fire tube was replaced while the boiler was in use, it being near the end of the tube in the front head. Any amount of pressure could be put on the



REPAIR OF A FIRE TUBE

sheet packing by running the nut down on the bolt, in effect making a jack with the bolt and gas pipe. The job remained tight almost a year, when the boiler was replaced by a new one of the water-tube type.

J. S.

Questions and Answers

Ask about your troubles—help the other fellow with his. Give your name and address. For a quick answer enclose stamp for reply.

Questions for Stationary Engineer

1. Why is a cylinder counter bored?
2. Why is clearance space allowed in a cylinder?
3. At what part of a boiler is the combustion chamber placed?
4. State in full what you would do in taking charge of a steam plant.
5. Draw a return-tubular boiler showing method of bracing furnace.
6. Draw a water-tube boiler showing furnace and setting.
7. What is a safety valve and what are your duties regarding it?
8. What is foaming and priming?
   (a) The cause.
   (b) The remedy.

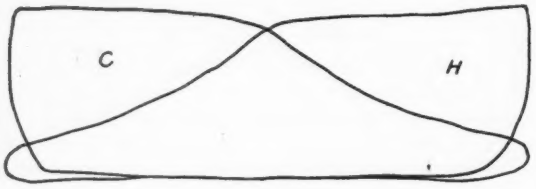


FIG. 1

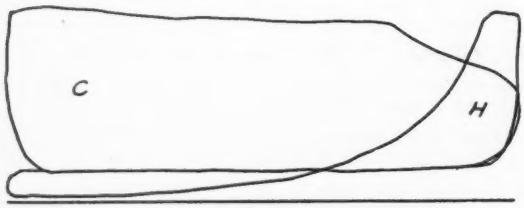


FIG. 2

FIG. 1. NORMAL DIAGRAM
FIG. 2. FREAK DIAGRAM TAKEN WITHOUT CHANGE OF VALVE SETTING

9. What parts of a return-tubular boiler are first effected by low water?
10. How would you set a water glass gage?
11. How would you tell if your water glass gage was set right?
12. How would you find the dead center of an engine?
13. If you found that the steam had gone 40-lb. above the blowoff pressure what would you do?
14. What would be the safe working pressure on a boiler with 3/8-in. sheet, 60,000 lb. stensile strength, 48 in. in diameter, double riveted?
15. What seams of a boiler are double riveted and why?
16. Define lap and lead.
17. How many valves has a duplex pump?
18. What is a lap joint?
19. What is a butt joint?
20. Which has the higher expansion?
21. What is meant by clearance?
22. Why is the space left between the lugs and jam nuts on a pump valve?
23. What is the period of expansion?
24. What is the duty of the flywheel?
25. In shutting off the steam pipe leading to the water glass what would the glass show?

Diagrams for Discussion

THESE 2 cards were taken without any change on the valve gear or engine. The engine is a cross-compound Corliss, 16 and 30 by 42-in. cylinders, speed 100 r.p.m., steam pressure 120 lb.

The cards were taken from the high-pressure cylinder. Can any reader of Practical Engineer explain this unusual card? The valves are set correctly. W. D.

Safety Valves; Breaking Gage Glass; Cause of Death by Electricity; Compression in Receiver; Grounding Generators

WE have 2 boilers, one old and one new, furnishing steam to engines at 150 lb. gage pressure. They are connected together by a steam pipe with a reducing valve in it. We have 2 safety valves of 2-in. and 4-in. diameters. We wish to have the old boiler blow off at 80 lb. gage pressure and new at 155 lb. On which boiler should we connect the 2-in. safety valve and on which the 4-in. and please give reasons for such connections? The boilers are of the same dimensions.

2. Why will a water gage glass notwithstand boiler pressures now common, often breaking without due cause?

3. Does an electric current of high voltage, when passing through the human body, lower the temperature of the body so as to cause death, or what is it that causes death to a person when a current of high voltage is passed through his body?

4. In a cross-compound Corliss engine, noncondensing, taking steam at 150 lb. boiler pressure and high pressure exhausting into receiver at 25 lb. pressure, is there at any time in the operation of the engine, compression going on between high and low pressure sides, providing the valves are set so as to run the engines at high economy, when carrying constant load?

5. Why are alternating and direct current generators grounded?

Please show different methods of grounding such machine. N. C. D.

A. The pressure at which a safety valve will blow off does not depend upon the diameter of the valve, but upon the adjustment. The thing which

the diameter of the valve controls is its capacity for carrying off steam. The larger valve should be put on the boiler of larger horsepower regardless of pressure. Then the valves should be set carefully for the pressure at which they are expected to blow. The method of adjusting for pressure varies with the make of safety valve but in general, consists of increasing the pressure on the spring of the valve.

On the 2 boilers you have, if they are of the same horsepower, the larger valve would naturally go on the lower pressure boiler because at 80 lb. pressure a pound of steam occupies 4.6 cu. ft. while at 155 lb. pressure it occupies 2.7 cu. ft. For the same number of pounds of steam discharged therefore, the low pressure boiler would require a larger diameter valve.

2. The breakage of water glasses is somewhat on a par with the breakage of lamp chimneys. It classes with the mysterious dispensation of Providence. These are all, however, results of some natural cause, usually from some strain put on the gage glass when putting it into the water column or from cold metal of the gage glass fittings touching the glass at some point and causing a cold spot there which makes an unequal expansion in the glass.

3. Electrical current kills by breaking down the tissues of the body. The reason that low voltage current does not kill is because the resistance of the body is so great that not enough current is sent through to break up the tissues. When the voltage is increased beyond a certain point, the current becomes strong enough to actually puncture the tissues inside the body and thus cause a breaking down of the bodily functions.

4. A condition of compression is practically impossible between high and low pressure cylinders of a compound engine where a receiver is used. With an engine, having valves set at 90 deg. and a very small receiver, there is the possibility that at a certain point the high pressure cylinder may be discharging into the receiver thus raising the receiver pressure and of course, there is a time when the high pressure cylinder is exhausting steam into the receiver and at the same time the low pressure cylinder is taking steam from the receiver. Usually in this case the low pressure is taking out steam faster than the high pressure puts it in, so that the receiver pressure is falling. Evidently, the low pressure cylinder never puts steam back into the receiver so that it can have no effect in raising the receiver pressure.

5. The reason for grounded generators is to avoid the static shock which the dynamo tender might get if the machine were not grounded. The condition of having the electric current at rather high voltage in the windings of a dynamo possesses a tendency for a charge of static electricity to accumulate on the frame of the machine and if it be insulated from the ground, this charge may get sufficiently high to be unpleasant to receive.

If the machine be grounded either by holding it on a concrete foundation or by carrying a coiled wire connection from the frame to a water pipe or the damp earth, the static charge is carried off as fast as it forms, and does not therefore accumulate to make trouble.

Horsepower of Shafting

IS there a standard rule for finding the horsepower that a shafting will transmit and the size of key it should have for any diameter, and how far apart should the bearings be placed? F. T. R.

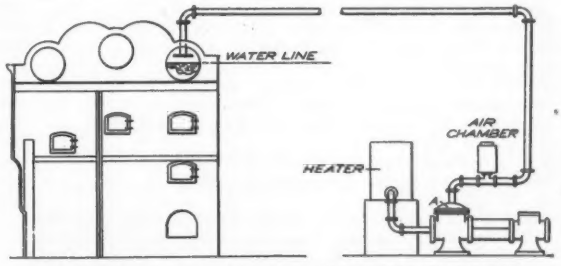
A. The matter of size of shafting involves 2 things: First, the bending pull on the shaft due to the belts, weights of wheels, etc., and second, the twisting, or, as it is called, the torsion effect due to the power transmitted. This makes a complicated condition which cannot be easily expressed in the form of a rule. Omitting the bending effect, the horsepower of a main shaft is the cube of the diameter expressed in inches, times the revolutions per minute, divided by 125, and for a line shaft it is the cube of the diameter times the revolutions divided by 80.

As to the spacing of bearings, Jones & Laughlin give for a 2-in. shaft 15½ ft. apart centers, 3-in. shaft 18 ft., 4-in. shaft 19½ ft., 5-in. shaft 21 ft., 6-in. shaft 22½ ft. This is for shafts having no transverse strain except their own weight. Where the line shaft carries a fair proportion of pulleys a 1½-in. shaft should have bearings 7-ft. centers, 2-in. shaft 8 ft., 2½-in. shaft 9 ft., 3-in. shaft 10 ft., 3½-in. shaft 11 ft., 4-in. shaft 12 ft., 5-in. shaft 13½ ft., 6-in. shaft 15 ft. These distances are arranged to give sufficient strength and to prevent vibration.

Pound in Pump

I HAVE a pump connected to a boiler and taking its water from a heater which is 4 ft. higher than the pump. The water is at about 180 degrees F. and the pump had no air chamber. I, therefore, made one out of 8-in. pipe 2½ ft. long and connected it as shown in the sketch. The discharge into the boiler is above the water line. The pump valves knock badly. I would like to know how to stop this knock or water hammer. Should the discharge pipe be put into the mud drum? H. C. M.

A. We would suggest, first, that the air chamber be connected directly to the water discharge chamber of the pump instead of into the discharge line at some distance from the pump. Second, the feed pipe need not necessarily enter the mud drum, but for a Stirling boiler, as shown, it should enter the upper rear drum, preferably at the top, and be extended downward to within a short distance, say 2 in., of the bottom of the drum, so that the feed water will not mingle directly with the steam. Third, according to your sketch, no check valve is put on the feed pipe between the pump and the boiler. A check valve should be used and be placed as close to the boiler as possible to get it.



CONNECTION OF PUMP AND FEED LINE TO BOILER

If the feed pipe is connected as shown, merely entering the drum and discharging into the steam space, it is no wonder that there is a knock in the pump. Feed water entering the pump is rather hot, at 185 degrees F., but this should cause no trouble if the pump is properly connected. C. F. Swingle.

NEXT TO THE RAW material itself, mechanical power is the basis upon which all industry rests, and what can be more significant of improved conditions than the additions now being made to power generating and driving machinery?

PRACTICAL ENGINEER

PUBLISHED ON THE FIRST OF EACH MONTH
at 355 Dearborn Street, Chicago, Ill., by the
TECHNICAL PUBLISHING CO.

NEW YORK, 150 Nassau Street. PHILADELPHIA, The Bourse.

Subscription Price One Dollar a year in advance to any Post Office in the United States and Mexico or United States possessions.

To Canada One Dollar and Fifty Cents; to Other Countries Two Dollars a year. Single copies 10 cents.

Address all letters and make all checks and money orders payable to Technical Publishing Co., 355 Dearborn Street, Chicago, Ill. Notify us at once of any change of address, giving the old and the new address, so that your paper may always reach you promptly.

Any advertiser is invited to examine our paid subscription lists and Post Office mailing receipts at any time.

Entered as second class matter May 1, 1908, at the Post Office at Chicago, Illinois, under the Act of March 3, 1879.

Circulation of this issue, 20,500.

CONTENTS

Power in a Packing House. Illustrated....467
Boiler Feed Pumps. By N. G. Neer....472
Valve Bronze Compositions. By Wm. H. Wonfor....473
The Fuel Economizer. By Carl S. Dow. Illustrated....474
Cooling Tower. By M. R. Bump. Illustrated....476
Marine Suction Producer Engines. Illustrated....478
Making Engineers for Gas Engines. By Harry H. Yates..479
Large Gas Engines. By J. D. Lyon. Illustrated....480
Why It Is Unnecessary to Compound a Gas Engine. By Chas. A. Haeussler. Illustrated....482
Utilizing Producer Gas for Heating....483
Refrigerating Machinery and Appliances. By H. D. Pownall. Illustrated....484
Valve Diagrams. Illustrated....487
Power Plant and Piping of the Boston Beer Co....490
A 42 Per Cent Saving in Lubrication....491
Comparative Tests of Lighting Systems. By J. G. Henninger. Illustrated....492
Dynamo and Motor Troubles. By John A. Voss....494
Isolated Plant Cost. Illustrated....495
Boiler Explosion and the Motor Drive....495
How the New Chief Made Good. By Geo. H. Wallace...496
Power from Exhaust Steam. Illustrated....499
New York's Municipal Office Building. Illustrated....500
Cutting Oil Costs....501
Direct Readings from a Slide Rule. Illustrated....502
Horsepower of Manila Transmission Rope....502
Cost of Power....503
Letters from Engineers: Cylinder Lubricating Schemes. Shrinkage of Water. Vacuum Cleaning for Electrical Equipment. A Novel Arrangement of Steam Traps. Diagrams from Hamilton Corliss Engine. A Hoisting Engineer's Duty. Belt for Multiple Drive. A Home Made Separator. Lubrication; Noisy Gears; Valve Adjustment. Method of Keying Flywheels. Vacuum Cleaner to Remove Soot. Engine Accident and Repair. Pump Valve Trouble and Remedy. Trouble with Metallic Packing. Leather Piston Rings. Impossible Suction Lift. Oiling Corliss Valves. Repair for Fire Tube Boiler. Illustrated....504
Questions and Answers: Questions for Stationary Engineers. Diagrams for Discussion. Safety Valves; Breaking Gage Glass; cause of Death by Electricity; Compression in Receiver; Grounding Generators. Horsepower of shafting. Pound in Pump. Illustrated....510
Editorial: Boiler Feed Pumps. Meeting Responsibility..512
Editorial Chat: Off Duty....513
A Hot Time in Hamilton. Illustrated....514
Kentucky State Engineers. Illustrated....517
Wisconsin State N. A. S. E. Convention. Illustrated....518
Connecticut Engineers in State Convention Assembled at New Haven. Illustrated....520
Massachusetts Engineers at Lowell. Illustrated....521
Lubrication In a Modern Plant. By R. S. Keith. Illustrated....524
New York Store of Quaker City Rubber Co. Illustrated..526
Bristol-Durand Averaging Instrument. Illustrated....526
Noiseless Valve for Vacuum Heating Systems. Illustrated.527
Fan Salesmen's Convention. Illustrated....528
Steam Development....528

BOILER FEED PUMPS

In perhaps no other item in a plant is there so much confusion and hit-or-miss engineering as in choosing the pump for boiler feeding. Many engineers seem in doubt as to what a boiler horsepower calls for, and others have no idea as to pump capacity.

As originally set by the 1876 Centennial Commission, a boiler horsepower called for evaporating 30 lb. of water an hour from 100 deg. F. into steam at 70 lb. pressure. Evidently this was not a good basis on which to figure for feed-water temperature is seldom at 100 deg. and in modern practise pressure is almost never 70 lb.; but the unit fitted fairly well average conditions at the time it was adopted.

For the sake of comparison, the equivalent evaporation from feed water at 212 deg. to steam at 212 deg. was chosen and this for one boiler horsepower worked out nearly to 34.5 lb., so that when revising the code the figure of 34.5 lb. equivalent evaporation from and at 212 deg. was adopted.

Under any other conditions than from 100 deg. and at 70 lb. the boiler horsepower is, therefore, not 30 lb. evaporation, but the difference will not be great, and allowances for slip and friction more than take care of it, so that in determining the size of the feed pump the value of 30 lb. per hour per horsepower is commonly used.

To give greater accuracy and convenient values for computation, the tables on p. 472 are well arranged, and show conservative values of the boiler capacity which commercial sizes of pumps will supply. They do away with any occasion for haphazard choosing or need of tiresome and awkward computations on pump cylinder volumes and piston speeds to get the pump rightly proportioned to boiler capacity. If a boiler is to be forced hard most of the time, some allowance should be made for extra capacity, but the figures as given allow for any ordinary degree of forcing.

MEETING RESPONSIBILITY

Whether he will or no the engineer in modern life must meet continually increasing responsibility. Bigger bridges, longer transmission lines at higher voltage, more powerful engines, higher pressure steam have come and will keep on coming. And only the engineer can take the responsibility for building and caring for these masterpieces which his ingenuity has made possible. There is nobody else capable of the task.

Then comes the question, how shall this increasing responsibility be met? Certainly not by waiting until an emergency demands prompt action and decision and then trying to look up the needed facts. Lawyers may get a case put over while they look up precedents, but an engineer with a thousand people waiting for light in their homes or power for their trolley ride can get no postponement. He must act now!

To keep up with progress he must learn to economize his time; to read those things which he needs,

to save his strength for his "musts," to choose those books, those tools, those papers, and those friends that help in growth and ability. While he must be deeply rooted in his special work he must spread at the top to be in touch with many details, and growth must be outward as well as upward.

In an address before the graduating class of the Clarkson Memorial School of Technology, Mr. Lewis well summarizes the traits of character which should be cultivated as industry, intelligent application, accuracy, self-reliance, tactfulness, integrity; and he might well have added an earnest curiosity which always asks "why?" For the engineer who accepts statements without understanding the reason is soon if not already a "rule of thumb" engineer, and modern responsibilities are of such nature and the consequences of mistakes are so serious that the rule of thumb man has no place among them. To measure up to the needs of to-day one must know not only "how" but "why" and must be able to tell what should be done as well as what has been done. Those who are fully meeting the demands of the times have no cause to complain of the rewards. Those who will not climb out of a rut or who are so deep in that they cannot find, of course, only what the rut holds, and, however unfortunate for them, will sooner or later be crumpled by the wheels of progress for the new responsibilities must be met by engineers ready to carry them.

EDITORIAL CHAT

OFF DUTY

It would seem that the old proverb about necessity going to the maternity hospital when a new invention is demanded is as true now as ever. Of course we have known for a long time of the casual remarks of the calamity howlers who keep track of such things that our natural stores of fertilizers from the islands and Chile were soon to disappear and leave humanity to have a parley with starvation.

Also we have gone our way contentedly, as is the custom of humanity, satisfied that we have enough for to-day's wants and trusting to old mother Necessity to produce twins or triplets to meet future wants.

Ever since our schoolbook days we have known (or forgotten) that the air is 4-5 nitrogen, and this same Nitrogen is the vital element of fertilizers as well as gunpowder and laughing gas, so of course, "get it from the air." That sounds easy, but to catch the nitrogen or "fix" it so that it can be placed where wanted has proved a problem by no means easy. Many good dollars and much ingenuity were expended in finding an electrical process for making the air nitrogen into nitric acid. Yes, it worked, but the cost was something enormous—too great for commercial success.

It's a mysterious kind of a process; one that goes on when plants or animal matter decays, but that is a slow method. It also goes on when some plants grow by the action of certain bacteria which also are active during decomposition. This bacteria business is getting to be the greatest thing on earth. Just find a new one and your name goes wriggling down in history as a benefactor of the first water. But getting at these minutely subdivided bugs is helping us to know what we're about instead of going it blind.

And so now comes Dr. G. Earp-Thomas from New Jersey with his bugs for getting nitrogen out of the air and into the ground where it will help to grow crops of wonderful size. It works like a vaccination; take some germs from the roots of a plant like clover, peas, beans and the jovial peanut and put them on the seed—and the germs do the rest. Buy them by the bottle; they not only double your crop but the soil will be improved for years to come. Sounds like a patent medicine ad. but the results seem to bear out the claims. Miss Birdsall in Harper's Weekly for July 16, tells about it and shows some photographs of results. And the cost is less than $2 an acre. Thus does the union of Necessity and Science result in another invention to ward off the immediate destruction or distress of mankind.

By act of congress of May 16, 1910, which became effective July 1, the work in regard to the investigation of fuels and their use, heretofore carried on by the Technologic Branch of the Geological Survey, will be transferred to the new Bureau of Mines. An appropriation of $100,000 was made by this act for anaylzing and testing of coals, lignites, ores and other mineral fuel substances belonging to or for the use of the United States. Of this amount $35,000 will be spent in chemical and physical investigation of fuels, $25,000 in inspection of government fuel purchases, $22,000 in fuel efficiency investigations, $5000 in lignite and peat investigations, and $4000 in briquetting experiments. The work already done by the Geological Survey in these fuel investigations has resulted in a better understanding throughout the country of the value of fuels and establishment of a scientific basis for purchase of fuel by the government. Publications of the Survey in regard to both mine and fuel investigations will in future be sent out by the Bureau of Mines. Publications which the Bureau of Mines has in course of preparation for bulletins are the Volatile Matter of Coal, Coal Analysis, Final Data Regarding Steam Tests, North Dakota Lignite as Boiler Fuel, Producer Gas Tests, Coals for Illuminating Gas, and Petroleum for Burning under Steam Boilers. When issued these can be obtained by addressing the Director of the Bureau of Mines, Washington, D. C.

He whose day's work brings no satisfaction, no desire for greater accomplishment tomorrow, needs his valve gear reset.

Our doubts are traitors, and make us lose the good we oft might win, by fearing to attempt.—Shakespeare.

A HOT TIME IN HAMILTON

WITH BIG ATTENDANCE AND ENTHUSIASM

THE weather man started it and the delegates did the rest, which accounts for the fact that in Hamilton, June 16 to 18, the temperature was some 40 deg. higher than in the surrounding country. Wednesday night there was a slight indication of what was coming, but the real trouble did not begin until Thursday morning. Then the delegates descended on Hamilton in large numbers and opened things up. The local committee had been putting in hard licks for some time and had arranged a beautifully decorated hall for the use of exhibitors, which was entirely filled, and there were some left-overs who did not get space, but there was room for all the delegates and everything was in convenient arrangement to be seen.

Convention meetings were held in the Junior O. U. A. M. Hall and the exhibits were located across the street in Jacobs Hall. On Thursday morning G. W. Rice of the local committee called the convention to order and Mayor Rothwell welcomed the delegates and visitors, inviting them to use his name to secure admission to the Hamilton Club, a favor of which many availed themselves. All the shops in Hamilton were open to inspection by the visitors and the engineers made the most of this opportunity.

Other addresses of the morning were by Frank H. Yeager of Cincinnati, and by J. J. Murphy of the Hooven, Owens, Rentschler Co., and by national and state officers. The town was decorated with flags, welcoming the association, which were tastefully arranged on all the chief business houses. The time of Thursday was taken up largely with the committee work, seating delegates and reports of the officers. In the afternoon matter of a meeting place was taken up and Cincinnati was chosen as the location for the 1911 State Convention and it was also voted that effort should be made to secure the National Convention for 1911 in Cincinnati.

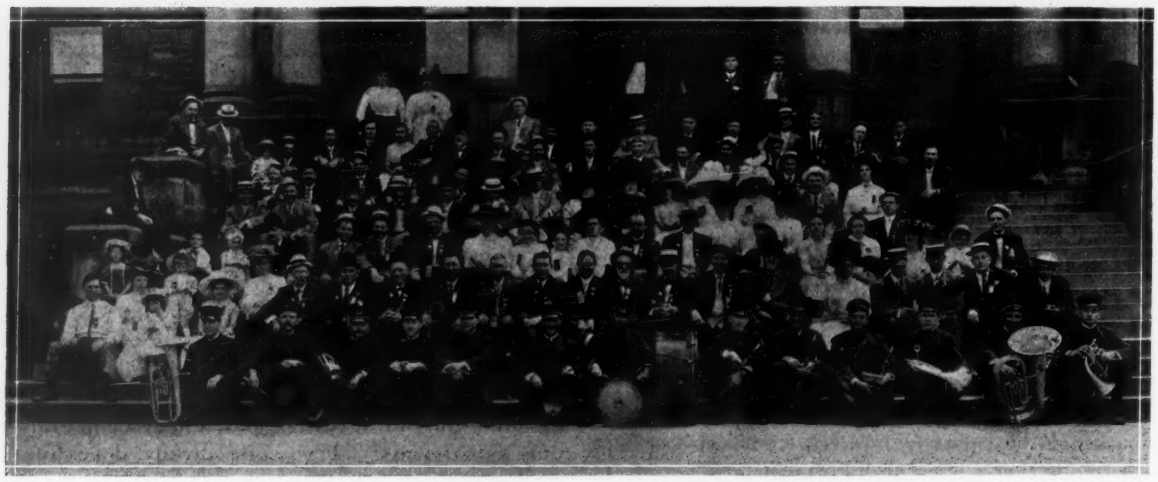
Thursday evening the Ladies' Auxiliary entertained with a euchre party, followed by a dance in Howe's Hall, an event which was very successful, both as to numbers in attendance and the pleasure of the evening.

Friday's session was taken up chiefly with the matter of legislation, the principal feature being an address by John Fehrenbatch of Cincinnati, who urged that the State Examiner should be given complete jurisdiction over defective boilers, with power to close any plant where the management refused to repair a bad boiler, the idea being to secure an absolute guarantee of safety for life and property.

Visit to Hamilton-Corliss Works

FRIDAY afternoon was taken up with an automobile trip to the different manufacturing industries of Hamilton, the first and most interesting visit, which might well rank as a large educational feature of the convention, being to the works of the Hooven, Owens, Rentschler Co., where the Hamilton-Corliss engine is built. The entire freedom of the plant was given to the visitors and they were able to see under construction 4 large pumping engines for the city of Brooklyn, N. Y., which were part of an order of 9 being constructed for that city. These engines are triple expansion, having steam cylinders 28, 50 and 80 in. in diameter by 60 in. stroke, and with a capacity for each engine of 25,000,000 gal. in 24 hr.

There were also seen under construction cross-compound engines, 42 and 86 by 60 in., which are to be direct connected to 2700-kw. generators, the total weight of the engines being 500 tons. In this engine the main shaft is 34 in. in diameter by 28 ft. long with a 10-in. hole through the center of the shaft. The weight of the shaft alone is 36 tons and with wheel hub and crank the weight is 80 tons; the weight of the bed is 60 tons. In another part of the shop was a tandem-compound engine for rolling mill work with cylinders 28 and 56 by 54 in., the complete weight being 200 tons. Numerous small engines were in the course of construction, ranging in power from 200 to 1500 hp., mainly of the heavy duty type, one-piece design and with the new type of valve gear release.



GROUP AT THE OHIO STATE N. A. S. E. CONVENTION

Equipment of the works was a fine example of modern provision for rapid, high-grade manufacturing, all machinery being specially designed for the work that it has to do and the entire equipment being practically new machines. In the foundry there were a number of examples of large loam work, including the mould for an 86-in. cylinder which was under way. The foundry equipment was of the best, all flasks being of iron, and equipment provided for handling flasks and castings, with 5 cranes in the foundry and a large crane in the castings storage yard between the foundry and pattern shop. Three cupolas are provided for rapid melting of iron and pouring of castings.

The shop is likewise equipped with 16 cranes, from 30 to 50 tons capacity, of the latest design for rapid handling of heavy work in passing through the various machining processes. Transportation to and from the shops is convenient, as spur tracks on the Pennsylvania and the C. H. & D. railroads run directly into both shop and foundry, making the shipment of heavy work an easy matter.

The courtesy shown by the company in taking visitors to the shops and in providing guides to conduct parties through and explain the work being done was greatly appreciated by all.

Another interesting trip was that to the factory of the Hamilton Coated Paper Co., the home of Champion Coated Paper and the place where the paper for the government printing and the cardboard stock for postal cards is manufactured.

On Friday evening a theatre party at the Grand was provided as entertainment. Saturday morning was given to the election of officers and installation and to the concluding business. Officers elected for the coming year were: President, Harry Eichorn, Columbus; vice-president, J. J. Coughlin, Hamilton; secretary, J. J. Ahlers, Cincinnati; treasurer, J. C. Radigan, Cleveland; conductor, Caspar Geise, Delphos; doorkeeper, Wm. Long, Toledo; state deputy, J. F. Synnett, Dayton.

Saturday afternoon the delegates and visitors were taken for a picnic to the grounds of the Cincinnati Brewery, as the guests of Max Tanner, C. E.

Who Was Who Among the Exhibitors

THE very first thing that happened in the exhibits was the Crandall Packing Co., right at the top of the stairs. There was no elevator; if there had been the No. 116 Lip packing would have been the right thing to use on the plunger. This is a special for outside packed plungers and was one of the many things explained by J. M. Chapman and J. S. Stout. Other features of the exhibit were Helios Sheet Packing, Kymoi Sheet Packing and the Combination Diagonal.

COOLING BREEZES and the cool-looking light from Tungsten Lamps made the booth of the John L. Walker Co. particularly refreshing. This company deals in steam specialties and is the distributing agent for Hamilton and vicinity for many of the firms which made special exhibits of their own.

BRASS SPECIALTIES of the Lunkenheimer Co. were attractively arranged by Herbert R. Wunder, among them being the Duro blowoff valve, the Lunkenheimer mechanical oil pump, Renewo valves with renewable disks, the double disk Lunkenheimer gate valve, lubricators, whistles, gage cocks and other steam specialties.

KEYSTONE GREASE, the keystone of the lubrication system, is always the same and the Keystone Lubricating Co. is ready to prove it. They furnished samples for trial as well as oil cups in which to use the samples, through L. L. Lacey, the Pittsburg representative.

PRACTICAL ENGINEER served as headquarters for delegates and exhibitors, registration of visitors and distribution of badges being taken care of at Practical Engineer Booth. Many engineers took advantage of the great $3 offer which was made for 2 years' subscription and Swingle's Twentieth Century Hand Book.

THE GEO. W. LORD method for taking care of boiler troubles was fully explained by Edward McCarthy, the company's representative and by the book on Boiler Troubles and Their Treatment. F. M. Leflar was also present for the company.

ALBANY GREASE and the name of Cook are inseparably connected. The Albany Lubricating Co., which is the successor to Adam Cook's Sons, or rather which is owned by Adam Cook's Sons, was represented by Silas C. Cook, who furnished samples of the only Albany Grease with cups for using it.

BROWNELL ENGINES and boilers are made on the level and E. J. Carolan gave proof of this to the delegates. Catalogs describing the Brownell high-speed engine, the high-pressure boiler and Brownell feed-water heater were distributed.

SMITH-VAILE steam pumps were illustrated by the duplex pump in the exhibit and Stillwell heaters by an open type heater located just outside the entrance to the building. J. E. Kamps represented the Platt Iron Works, which manufactures these goods.

AS ONE OF THE HOSTS for the convention, the Hooven, Owens, Rentschler Co. made special provision for the comfort of visitors. In a large double booth was a table for writing, telephone connection and inviting chairs. Photographs of the large engines made by the company and some notable installations decorated the booth, entrance to which was through an arch illuminated by colored incandescent lamps. A full-size throttle valve was on exhibit, also a full-size model of the new type of releasing mechanism for the Corliss Steam Valve. Representing the company at the exhibit were Don Hooven and O. D. Dillman, Mr. Dillman exhibiting also Single's automatic engine stop.

DART UNIONS, the Geipel steam trap made by John Platt & Co., and other specialties handled by the Fairbanks Co. were on exhibit in charge of J. A. Taft and Bartrum Richards.

F. W. NIEBLING, president of the F. W. Niebling Co., demonstrated his patent suction and discharge valves for ammonia compressors and showed also a line of valves and ammonia fittings of special design.

ARROW BOILER COMPOUNDS as made for the Arrow process were explained by F. A. Foster and E. W. Swindler.

WHITE STAR VALVES, Powell lubricators, the Cyclone blowoff valve and a full line of brass specialties made by the Wm. Powell Co. were displayed by Chas. E. McFarlan, vice-president of the company, and Chas. Cullen, special representative.

PALMETTO steam packings, Manhattan hydraulic packings and the Favorite Reversible ratchet wrench were the features shown by B. M. Bulkley in the exhibit of Greene, Tweed & Co.

"HAWKEYE compound made in bricks" was the text of the literature and discussions at the booth of the Hawkeye Compound Co., presided over by R. S. Everitt, G. A. Shaw and I. E. Cook.

AT THE ATTRACTIVE exhibit of the D. T. Williams Valve Co., which was composed of a frame of brass goods, including cups, sight-feed oilers and gage glass fittings as well as pyramids made up of unions and valves, the motto, "No extra seats or disks needed," was prominently displayed to emphasize the characteristics of the Williams Regrinding Valve. H. J. Ernst and Chas. Becker were the representatives.

ANDERSON MODEL D steam traps, having water gage, bypass, air valves, blowoff valves and sediment strainers, were the special feature shown by the V. D. Anderson Co. The strainer and sediment chamber prevents any sediment or scale getting into the valve and the arrangement of valves is such that all parts can be removed without breaking a steam joint or pipe connection. Also the valve is always locked by at least 3 in. of water. Copper floats of all sizes were also a part of the exhibit, which was in charge of Joseph H. Meyer and Henry J. Meyer.

PEERLESS RUBBER goods shown in detail by the Peerless Rubber Co., included the regular line of Rainbow sheet packing, Elipse gaskets and other steam specialties and also Success semimetallic Diagonal packing for plungers and rods, Rainbestos high-pressure and superheat packing made up for flanges, pistons and rods and consisting of an asbestos with rubber backing. Samples of hose were also shown, including a special air hose, Lakeside steam hose, Peerless steam drill hose, and the regular line for hot and cold water. Wm. C. Briggs and H. S. Lewis were in charge of the exhibit.

CAREY'S GOODS and specialties made of asbestos and magnesia by the Philip Carey Co. were shown by John Gartner and T. J. Dempsey, representatives of the G. A. Weigel Co.

THE LIMBERT Successful Flue Blower Co. showed a full-size model of its blower and gave 7 reasons why this is "The best by test." S. H. Limbert represented the company.

THE ARMSTRONG Shaking grate bar is made in a single piece, resting on side bearers and has interlocking fingers which pass between each other, stirring the fuel bed thoroughly. W. M. Armstrong represented the Armstrong Mfg. Co., which makes this grate.

OSBORNE MONNETT represented the Hill Publishing Co.

DEARBORN SPECIALTIES, including boiler compounds, lubricating oils and industrial chemicals made by the Dearborn Drug & Chemical Works, were represented by Dan Delaney, E. H. Ruhlman and L. W. O'Brian. Those who passed the booth were fragrantly as well as financially rewarded.

S. A. WEBB and W. S. Cushion represented Southern Engineer.

STEEL MIXTURE was pleasingly demonstrated by John Harley and A. W. Pettie, who showed the model "steel mixture" setting for a boiler and also demonstrated the difference in quality between this and other materials for such work.

OILDAG AND GREDAG were shown and their qualities convincingly proven in the exhibit of the Acheson Graphite Co., by R. B. Clarge and G. W. Vasbinder. The Acheson Co. are the only makers of graphite in the world and have provided a great oil saver for engineers.

INDIAN OILS and greases and the Packard Universal Point graphited grease were the exhibit of the Indian Refining Co.

SAMPLES of Viruco sheet packing were furnished by H. B. Ewart, representative of the Victor Rubber Co., and were guaranteed to hold in flange joints subject to vibration or water hammer if the alignment of facings is reasonably good.

PACKINGS made by the H. W. Johns-Manville Co. were the special feature of its exhibit. These included Kearsarge, Victor and Duro spiral packings, Permanite sheet packing, metallic ring packing with a bronze packing ring so inserted that there can be no tilting, Kearsarge gaskets moulded to shape and other packing specialties. E. E. Skinner, H. W. McKinley and G. A. Lewis were the representatives.

A PORTABLE TESTING set for gages and tools for repairing them were an exceedingly interesting feature of the exhibit of the American Steam Gage & Valve Mfg. Co. Other features were the American recording gages and sectional model of the American pop valve and the American Pocket planimeter. Chas. C. Kilander, manager of the western branch at Chicago, had the interests of the company in charge.

JOHN A. ROEBLING Sons Co., manufacturers of wire rope, were represented by J. W. Brooks and W. W. Affleck.

"THAT GOOD OIL" made by Chas. H. Moore & Co. was displayed in oil jars, and the Autlobo Oil & Grease was shown in cans as delivered. A. Lewis and A. W. H. Jamieson demonstrated the advantages of these oils.

GARLOCK brand packings carry the rule and caliper trademark. Those shown included packings for all purposes, especially the No. 900 sheet and the metallic and high-pressure types. Garlock metal polish was another specialty shown. Representing the Garlock interests there were J. J. Pokorney, C. J. Carr, E. P. Watrous, Wm. Hulvershorn, C. V. Whitehouse and B. B. Franklin.

IN THE BOOTH of the Murdock Mfg. & Supply Co., whose special representative was W. E. Perkins, many prominent manufacturers were represented.

THE S-C Regulator Co. exhibited the S-C Regulator and Pump Governor, and the New S-C Damper Regulator, N. G. Copley, secretary of the company, being the exhibitor.

FOR the Borden Co., J. H. Lehman showed samples of the Beaver Die Stocks equipped with the now universal chuck and expansion dies. In this stock there are no loose pieces; the barrel is detachable for the replacement of dies so that the stock is complete. Each stock cuts 4 or more sizes of pipe to exact sizes, or to over or under size as may be necessary. The No. 6 stock takes pipe from ¼ to ¾ in., No. 25 B from 1 to 2 in., No. 41 from 2½ to 4 in., and No. 60 from 2½ to 6 in.

FOR the Pittsburg Feed Water Heater Co., J. E. Schlieper explained the details and advantages of the Pittsburg heater. Other specialties in the Murdock Co.'s exhibit were the Direct Separators made by the Direct Separator Co., the Everlasting blowoff valve made by the Sculley Steel & Iron Co., Lunkenheimer valves, the Little Giant steam trap with double brass diaphragm and valve on top of the diaphragm and the Webco union with nickel bronze seat.

TAURIL is the fibrous sheet packing made by the Anchor Packing Co. and is a special feature of its exhibits. Besides this is the metallic twist, metallic ring packing for rods, and all styles of gaskets, both round

and square. G. A. Morrison, J. L. Patten and F. G. Breiner looked after visitors to the booth.

COLUMBUS DILL of the Ashton Valve Co. renewed his acquaintance, which included practically every person at the convention.

LAGONDA MFG. CO., besides its regular line of Weinland cleaners and heads, showed some of the "awful tubes" that have been remedied by this cleaner and the spear and star wheel heads which are used for various classes of work. A new addition to the Lagonda apparatus is the Enterprise strainer with detachable bonnet, having 3, 4 or 5 baskets, with brass seats and valves, all handled from the top of the strainer, also the water cleaner W216, of special heavy construction for Sterling Boilers. M. M. Sellers and C. A. Conn were the representatives.

JENKINS BROS. Standard line of valves and packings was shown by H. C. McLaughlin of the New York office. Besides this were shown the pump disk valves, which include the No. 80 for hot water up to 250 lb. pressure and from 180 to 300 deg. temperature; No. 88 for warm water up to 100 lb. pressure and cold water from 50 to 400 lb. pressure; the No. 93 for 150 lb. pressure and for 100 lb. pressure with temperature not over 180 deg.; No. 94 for cold water up to 100 lb. pressure, and No. 15 for cold water up to 75 lb. pressure and for condenser air pumps.

KENTUCKY STATE ENGINEERS

KENTUCKY State Convention, recently held at Hopkinsville, has passed into history, but left an aftermath in the memory of those who were fortunate witnesses of the ability of the members of No. 10 to please the wants of the inner man. A sumptuous feast of young sheep was served at Campbell's Cave, a short distance out of the city, to which all did justice.

The large group photograph was taken at the entrance to this peculiar dent in the rock which forms in part a large hill, and likewise a roof sufficient to shelter a small army.

The noticeable feature of this affair is the entire absence of ladies, an unusual procedure, and a feature that is detrimental to the good results sought for in such gatherings.

The second group is the new officers, and reading from left to right they are: Sitting—Asa Williams, vice president; F. L. Ray, president; F. W. Raven, national secretary; J. N. Draper, past president; C. Carroll, conductor. Standing—J. H. Oelze, treasurer; J. L. Harpole, secretary; William Cummins, doorkeeper.

Display of the supply men was up to date and a pleasing feature of the convention.

Louisville was chosen as the convention city for 1911.

Sessions were held in Odd Fellows' lodge room which was well filled. J. L. Schrode called the convention to order and introduced Mayor Meacham who welcomed visitors to Hopkinsville, which was responded to by J. N. Draper, state president. Business followed until adjournment, which was the signal for expressing actively, appreciation of the hospitable luncheon provided by the hosts.

OFFICERS OF THE KENTUCKY STATE ASSOCIATION

Evening of Friday was taken up with a smoker and program. Mr. Raven outlined the objects of the association and the benefits to the community as well as to members. After selections by a local quartet, F. L. Ray gave an address on Technical Education for the Engineers and How to Get It, showing the value of home study and giving valuable suggestions as to methods.

The Engineer as a Citizen, was the subject of Prof. Hamlett and his standing as it is and as it ought to be were well outlined.

Legerdemain by J. L. Schrode and a talk by J. H. Meyer for the supply men closed the meeting.

Saturday morning election of officers already named was in order and they were installed by F. W. Raven of Chicago, assisted by O. Monnett. Louisville was chosen as the convention city for 1911.

DELEGATES AND VISITORS AT THE HOPKINSVILLE, KY., MEETING

WISCONSIN STATE N. A. S. E. CONVENTION

OSHKOSH, JUNE 16-19

NOTHING but a sudden spell of hot weather interfered with the pleasure of Wisconsin engineers who were gathered for the tenth annual convention in one of the most beautiful resort cities of the country. As a fitting opening for the convention an informal reception was given on Thursday evening in the N. A. S. E. Hall by the local association to delegates, visitors and supply men. The evening was spent in dancing, interspersed with instrumental and vocal music, short speeches and refreshments.

The first regular session of the convention was held Friday morning in the City Hall. Isaac H. Crawford acted as chairman at the meeting and introduced Mayor John C. Voss, who extended the hospitalities of Oshkosh to the engineers and their friends, pointing out the many things of interest in the city to people interested in industrial development of the state.

Response to the mayor's address of welcome was given by the state president, A. P. Balzer, who assured the mayor that the engineers were pleased to accept his hospitality and congratulated the citizens of Oshkosh on their enterprise and pride in local affairs. He further made clear the objects of the association in the developing of the members, not only as engineers, but as citizens.

DELEGATES AND LADIES AT THE WISCONSIN CONVENTION

Fred W. Raven, national secretary, gave a short address upon the principles of the association, objects to be attained by its members, its development and future possibilities.

The relation of the trade press to the operating engineer was discussed in a short address by R. E. Turner of Practical Engineer, who pointed out the aims and objects of the up-to-date power plant journal and how the engineer could get the greatest value out of its pages.

A short talk on education was given by F. B. Fulmer, who is of the opinion that the first part of an education is to have the conceit taken out of the man, the second is in gaining a practical knowledge from books, and the third gaining practical experience through application of principles learned and observation.

The afternoon meeting was opened with an address given by A. P. Balzer, in which he brought out a number of features which he considered of great importance to the State Association. He emphasized the value of fraternity among the members of the various local associations which should extend to include the entire state and also surrounding states. He discussed the advantages to be gained by a graded state license law and recommended that the association use its utmost power to secure a desirable law for the state of Wisconsin.

The most important advantage to be gained by the members of the N. A. S. E., according to Mr. Balzer's statement, is through the educational features of the organization. As a stimulus for better education he advocated rivalry between state and subordinate associations. He also brought out in this address a number of criticisms which have been presented upon the methods of conducting the national conventions, stating that, in his opinion, these should be held biennially and that the delegates to these conventions should be selected by the state organizations rather than the local associations.

During the rest of this meeting routine business of the convention was carried on, committees appointed and the work gotten under way so it could be finished in one session Saturday.

While the delegates were carrying on the business of the association the visiting ladies were given a ride through the city in automobiles by the ladies of the local auxiliary.

Friday evening was given up to the educational side of the convention and at the meeting held in the N. A. S. E. Hall, W. A. Converse of the Dearborn Drug & Chemical Works, gave a lecture on "Boiler Feed Waters; What They Contain, and Why They Cause Trouble." The subject was handled from the standpoint of a chemist, but put in such language that the laymen could appreciate and understand the value of a scientific investigation of waters to be used in steam boilers. Samples of the various materials found in boiler scale were exhibited and a demonstration of the method employed for analyzing feed water was conducted during the progress of the lecture.

The balance of the evening was given over to W. H. Burnett of the American Radiator Co., who gave an illustrated talk on radiator valves and control of heating apparatus, employing steam or hot water, to give a uniform temperature at any desired point.

Saturday morning the officers for the ensuing year were elected as follows: A. A. Schroeder, La Crosse, president; A. LaBudde, Ashland, vice president; S. W. Marty, Oshkosh, secretary; John F. Murphy, Madison, treasurer; Richard Gaepel, Milwaukee, conductor; E. S. Wells, Stevens Point, doorkeeper; W. Clasmann, Milwaukee, state deputy. After the officers had been elected they were installed by F. W. Raven, who in his address congratulated them upon their advancement in the association and pointed out the importance of the officers in the development of the state organization.

The meeting place for the next annual convention was not decided upon, but was left to the decision of the newly elected officers. It is probable, however, that LaCrosse, Fond du Lac or Green Bay will be selected, as the delegates from these cities were working hard to secure the convention.

This closed the regular business of the convention and the afternoon and Sunday were spent in pleasure excursions provided by the local organization. Saturday afternoon the delegates and ladies at the convention were entertained by G. M. Paine, president

of the Paine Lumber Co. There were about 60 who availed themselves of the opportunity to go through the Paine Lumber Co.'s plant, which is stated to be the largest in the country making doors and sashes.

After this Mr. Paine took the party in his steam yacht Nia for a ride on the Fox River up to Lake Butte des Mortes, and returning steamed for a short time upon Lake Winnebago, leaving the party at the dock in the city.

The local entertainment committee chartered a boat for Saturday evening and took those interested in the convention to the Power Boat Club House on the bank of Lake Butte des Mortes, where dancing and refreshments were the order of the evening.

The big day of the pleasure side of the convention was on Sunday when the morning trains brought in a large number of engineers from various parts of the state, principally Milwaukee, and 3 boats were chartered by the entertainment committee to give the delegates and visitors a ride upon the lake. A picnic dinner was provided and in the afternoon a ball game was played between the engineers and supply men, the result of which no one seems to know except that a good time was enjoyed. Those who preferred a quiet life took fish poles along and enjoyed Nimrod's sport.

Among the Supply Men

WHEREVER engineers get together one can always expect and will find their friends, the supply men. The Wisconsin convention was no exception to this rule and the various houses manufacturing power-plant supplies and equipment had exhibits in the lobby of the Hotel Athearn, where tables and stands were provided for displaying their products.

An important step in the advancement of exhibits in the central states was taken at the Wisconsin convention when an association was organized to be known as the Central States Exhibitors' Association, the objects of which are to work in conjunction with the committees of the various state associations of the N. A. S. E. in securing proper exhibition halls and other features in connection with state conventions. At the meeting held Saturday evening Wm. Lyons of the Lyons Boiler Works was elected president and E. P. Gould of the Lunkenheimer Co. secretary of the organization.

It was proposed that these men secure the co-operation of manufacturing concerns in the engineering field and try out the advantages of such an organization upon exhibit to be given in St. Paul during the Minnesota state convention.

THE INDUSTRIAL HEATING & ENGINEERING Co., of Milwaukee, was represented by H. S. Bowers and exhibited Simons Automatic Vacuum Valve and Heintz's Steam Trap.

JENKINS BROS. had on exhibit a line of brass globe, angle and check valves, Palmetto twist packing, '96 sheet packing, ring packing, etc. J. C. Beckerleg of Chicago was in charge of the exhibit.

GEO. B. CARPENTER & CO. of Chicago handle the Peerless rubber goods, hoses, belts, packing, etc., and Chas. W. Reedy made a peerless representative.

THE AMERICAN STEAM GAUGE & VALVE MFG. CO. was represented by Mr. Ladewig, who displayed the American Thompson Improved Indicator and distributed literature on American H_2O Grease Extractor, gage boards, V. P. shaft speed indicators, safety valves, etc.

THE ALLIS CHALMERS CO. distributed literature on its products and was represented by L. M. Embry.

WM. C. CHURCHILL of Oshkosh exhibited the Weinland Tube Cleaner and distributed literature describing the products of the Lagonda Mfg. Co., pumps, condensers, etc., made by the M. T. Davidson Co., heaters, steam and oil separators and exhaust heads manufactured by Hoppes Mfg. Co.

THE LUNKENHEIMER CO. had a neat display of check valves, oil and grease cups, gas and gasoline engine accessories, Renewo globe valves, Duro blowoff valves, regrinding valves, gasoline strainers, whistles, etc., the advantages of which were explained by E. P. Gould by means of conventional blueprints and cross sections.

LYONS BOILER WORKS showed the construction and water circulation of its boiler by means of a miniature boiler of the Lyons type with a glass shell. Wm. P. Lyons was chief engineer and had his stationary engineer's license framed and hung in the boiler room to satisfy engineers that the boiler was safe in his care.

WESTERN VALVE CO. exhibited Fairbanks valves, Dart Unions and Simple's steam trap entire and in cross sections. The advantages of these devices were explained by Mr. Kaufman of the Chicago office.

AMERICAN RADIATOR CO. displayed a number of its heating specialties, such as reducing valves, Sylphon heating appliances for hot water and steam and illustrated their application to heating systems by means of photographs. W. H. Burnett was in charge of the exhibit.

H. W. JOHNS-MANVILLE CO. was represented by C. S. Padget and Frank F. Mohr. Asbestos goods, rubber goods, pipe covering, packing, gaskets, plumbers' supplies, electrical insulation, etc., made up an excellent exhibit for this company, which attracted deserved attention.

THE MARTIN ANTI-FRICTION ROCKING GRATE was exhibited by F. P. Bird of Horican, Wis.

HAWKEYE BOILER COMPOUND CO. had 3 representatives at the convention; these were R. N. Rockford, Geo. Kuehn and Theo. Brommenschenkel, who distributed literature describing the good points of their compound.

PRACTICAL ENGINEER had special propositions in the line of subscription inducements on hand and Swingle's Hand Book proved exceedingly interesting to all the engineers present.

DEARBORN DRUG & CHEMICAL WORKS is always on hand and at this convention W. A. Converse, E. T. Ward and J. R. Foster kept the engineers interested in its products, consisting of boiler feed water treatment and high grade lubricating oils.

THE GARLOCK PACKING CO. was represented by John R. Gish, who had a welcome for every body who needs packing and others interested.

WICKES BOILER CO. was represented by C. F. Wilson.

THE ROBERT ROM CO. of Milwaukee, manufacturers of steam specialties, sent L. G. Schertl to make friends for the company.

CRANDALL PACKING CO. was on hand with F. Brunner to give it publicity at the convention.

KEYSTONE LUBRICATING CO. was represented by Henry Helms.

CONNECTICUT ENGINEERS IN STATE CONVENTION ASSEMBLED AT NEW HAVEN

THE 15th Annual State Convention of the N. A. S. E., Connecticut, held in the Boardman Building, was called to order by President Geo. A. Cleaveland, of New Haven, at 10 o'clock on Friday. Appointment of committees, which was judiciously performed, as shown by the satisfactory manner in which the details of the convention were carried out, took up the first session, and adjournment of the business was then taken until 9 o'clock Saturday morning, the balance of the day being devoted to inspection of the exhibits in the connecting rooms and to social engagements.

Friday evening was occupied with an entertainment given by the New Haven members to delegates and visitors. After the inner man was attended to, a varied program of speeches, music, and recitations was rendered, the speaking being under the guidance of President Cleaveland who acted as toastmaster. He called the meeting to order, welcoming the convention to New Haven, and introduced Mayor Rice, who spoke of the important part played by the engineer in industrial life and of the commendable educational work carried on by the association.

ENGINEERS AND FRIENDS AT CONNECTICUT CONVENTION

National President W. J. Reynolds then spoke on the needs of the organization and of the duties of a good member. He emphasized the benefits from engineer's license law and urged that the Connecticut engineers work hard for the passage of such law, making personal appeals to the representatives for furtherance of such legislation. Following was an address by Past President Herbert E. Stone, who also spoke of the necessity of personal interest and of the advantages from life and accident features of the association.

Joshua O'Leary, New England representative of Practical Engineer, related some experiences from personal contact with engineers throughout New England and voiced the desire he had encountered that the association might broaden its activities to include recognition and compensation for engineers. Ed. Marooney, speaking of the work of the Ladies' Auxiliary, asked for co-operation with the ladies in their efforts to help disabled engineers and made a stirring appeal, which met with immediate and gratifying response.

Interspersed with the speeches were selections on the piano by Prof. Nichols, recitations by Jack Armour and Joshua O'Leary, all of which were well received.

The final session of the convention on Saturday morning was devoted to reports of officers and elections. The report of Secretary-Treasurer Vandenburgh showed a membership of 468, an increase of 30 per cent during the last year and a balance of $260 on hand. It was unanimously voted to renew at the fall session of the legislature the effort to secure passage of license law, and a committee was appointed to take charge of the matter, consisting of Henry Vandenburgh of Hartford, Geo. P. Thomas of Norwich, and P. J. Grace of Bridgeport. The convention expressed itself in favor of having the national convention for 1912 at Springfield, Mass. Messrs. Marooney, Grace and Thomas were appointed a committee to confer with the supply men in order to secure their co-operation in making a success of the convention.

Election of officers resulted in choosing as president Charles Ostrander, of Meriden; vice president, Frank L. Chapman of Norwich; secretary-treasurer, Henry Vandenburgh of Hartford; conductor, John A. Sherman, New Haven; doorkeeper, Thomas Reed, New Haven; state deputy, Chas. P. Langdon, of Tor-

rington. These officers were installed by Past National President Herbert E. Stone, and the meeting place for the next year was chosen as Hartford, in June.

The convention adjourned at 12:30 and all proceeded by special car to the Tabard Inn, near Lighthouse Point, where a shore dinner was enjoyed and afterward a game of baseball of the farce variety was perpetrated between the supply men and the engineers. The party returned by special car to New Haven and separated with cordial expressions of good will and thankfulness for the hospitality of the New Haven committees.

Exhibit Notes

IN the exhibit hall were seen fine displays from advertisers of national reputation and many from local dealers and supply houses. Among the largest exhibitors was the American Steam Gauge & Valve Co., of Boston, with a display of indicators and other brass goods, in charge of W. H. Nickerson.

THE LUNKENHEIMER CO., of Cincinnati, showed a fine line of brass and iron valves, lubricators, oil and grease cups and other supplies in charge of the competent representative, W. W. Beal.

H. W. JOHNS-MANVILLE CO., of New York, showed high-grade packings for all purposes in fabric, asbestos and rubber, pure and compounded, in charge of H. T. Lyman.

A UNIQUE AND STRIKING display was that of the General Electric Co., consisting of Mazda lamps, in charge of L. H. Lewis, manager of the New Haven office, W. D. Jennings, of the supply department, H. C. Hall, of the power and lighting department, and H. J. Maynard, of the lamp department.

A LARGE AND ATTRACTIVE line of valves, particularly pop safety valves, as well as steam gages, was shown by the Ashton Valve Co., of Boston, in charge of Chas. L. Buckman. The special alarm gage was a particular feature.

FOR THE HARRISON Safety Boiler Works, F. E. Idell made an effective presentation of its Cochrane heaters, separators and feed-water purifiers, in charge of W. W. Montaloos.

PAUL L. CROWE, manufacturer of the Crowe chain grate stokers, had an exhibit of castings of his grates and also of complete grates in position showing the adjustment, the air space obtained, the amount of which was 35 per cent, and the method of operation of the system.

JENKINS BROS., manufacturer of valves and packings, with offices in New York, Chicago, Boston, Philadelphia and London, made a notable exhibit of valve disks, 96 sheet packing, Jenkins' valves and the Sellers' injector, in charge of R. H. Styles.

A VERY EFFECTIVE display was that of the Keystone Lubricating Co., consisting of a large line of its standard lubricants, samples of which were presented in attractive packages to the delegates. This exhibit was in charge of F. Waldo Gordon.

HARDWARE AND PLUMBING goods were shown by C. S. Meesick & Co., in charge of C. H. Albee.

FOR THE HOME RUBBER CO., maker of N. B. O. and other packings for various uses, there were present J. B. Harrington, R. Foley, M. Ramsay and F. B. Driscoll.

CLEANING BOILERS by a new method was illustrated in the exhibit of the Connecticut Metal Boiler Cleaning Co., in charge of Louis Hallbauer, chief engineer, and F. H. Loomis, president of the company.

METALLIC STEAM HOSE, packings and steam traps were shown by the Hartford Mill Supply Co., represented by N. D. Merwin, H. A. Hamilton, Fred Upham and F. Evans.

M. T. DAVIDSON showed a line of the Davidson pumps, condensers, evaporators, etc., in charge of W. E. Brennan.

RED STAR BOILER COMPOUND, made by the Lake Erie Boiler Compound Co., was in charge of W. F. Hogg.

MASSACHUSETTS ENGINEERS AT LOWELL

15TH ANNUAL CONVENTION, JULY 7 TO 9

A LARGE banner suspended across Lowell's principal business street, and bearing the inscription, "Welcome, N. A. S. E.," heralded the opening on Thursday, July 7, of a very successful convention of the Massachusetts branch of the National Association of Stationary Engineers. Halls in the Runnels Building, in which the convention was held, were convenient of arrangement and easy of access, while the preparedness evident even to the first arrivals of delegates and exhibitors reflected much credit on the efficient committee in charge.

The Convention

THE convention was formally opened at 10:30 o'clock Friday morning, in Runnels Hall, by T. N. Kelsey, chairman of the committee on arrangements, who introduced Mayor John F. Meehan as the first speaker. Mayor Meehan extended a cordial welcome on behalf of the citizens of Lowell, and stated that it had been his fortune when in the state legislature to serve for 3 yr. on a committee that brought him in close touch with the aims and purposes of the engineers, and that he had formed a high estimate of the importance of their calling and of the great responsibilities devolving upon them, and nobly met by them. He specially commended the educational work of the Association and closed by expressing the hope that the experience of the delegates during their stay in Lowell would lead to an early return of the N. A. S. E. convention to the city.

Edward H. Kearney, state deputy, made an eloquent response in which he voiced the delegates' appreciation of the warm welcome extended, and gave assurance that the conduct of the delegates while in the city would justify the cordial invitation to "come again."

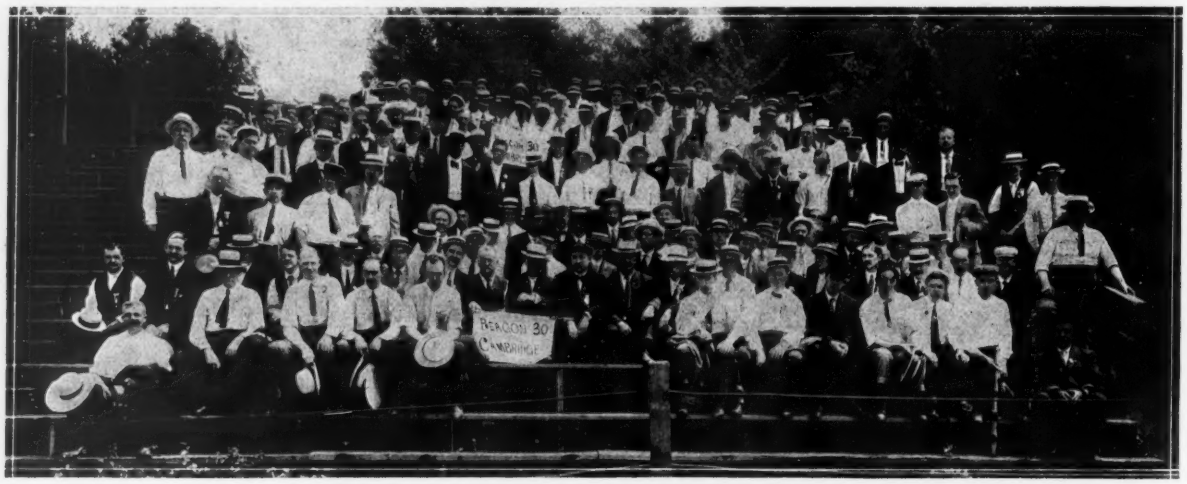
Harvey B. Greene, president of the Lowell Board of Trade, was next introduced, speaking interestingly of Lowell's business and social conditions, and expressed the appreciation of its business men of the important part played by the engineers in its industrial life. He formally extended a welcome from the business interests and conveyed their best wishes for the complete success of the convention.

F. L. Johnson, past president of the state association, was the next speaker. He emphasized the point that the development of machinery had effected great changes in the condition of skilled labor, and said that the engineer was to-day the last of "the all-round workmen" and one whose place could not be taken by any machine. He pointed out, however, that the central station, with spider-like webs, was reaching

out to mill and factory, and that its glib-tongued promoter was trying to push the engineers out to the sidewalk; but declared that the effort would be futile if the engineers were able to oppose the efforts of the promoter by educated and expert efficiency in meeting all attacks.

The last speaker was William J. Reynolds of Hoboken, N. J., national president of the N. A. S. E. President Reynolds, in opening, commented on the very orderly and harmonious character of the convention, which he said might not inappropriately have been held in a church, so free from friction or conflict were the proceedings. He paid high compliment to the Massachusetts organization; characterizing it as beyond question the best in the national association. He spoke at some length on the purposes and needs of the N. A. S. E. and counseled faithful attendance at meetings. He praised the engineers' license laws of Massachusetts and said he would be glad to get laws half as good in the other states of the Union.

At the close of President Reynolds' address State President P. V. Terrill took the chair and appointed the various committees, after which the meeting adjourned for dinner.



ENGINEERS AND FRIENDS AT MASSACHUSETTS CONVENTION

Afternoon

AT the afternoon session reports were received and a large amount of important business transacted. The reports of the secretary and treasurer showed a highly satisfactory condition of the organization, both in increased membership and financial resources.

The education committee reported having arranged 200 lectures during the year without expense to the state organization. Their service was recognized by a unanimous vote of thanks and an amendment to the constitution was adopted increasing the membership of the committee from 3 to 5.

It was voted to hold the convention of next year at Worcester in July, and it also voted to favor holding the convention of the national association at Springfield, Mass., in 1912.

A protest was received from Boston No. 12, against the present method of granting engineers' licenses, and the matter was referred to a special committee consisting of T. N. Kelsey of Lowell, Joseph Stratton of Fall River, and C. A. Cowles of Lynn.

After transacting some routine business the convention elected the following state officers for the ensuing year: President, George L. Finch of Cambridge; vice-president, James H. Sumner of Cambridge; secretary, Ole B. Peterson of Boston; treasurer, Walter H. Damon of Springfield; Albert Smith, chief engineer of the Massachusetts Institute of Technology, was recommended to the national president for appointment as state deputy.

A past president's jewel was presented to the retiring president, Preston V. Terrill, and a rising vote of thanks was given to the Lowell members for their hospitality, after which the convention adjourned.

In the evening a smoker and stage entertainment was given in Lincoln Hall, the program including brief addresses by Past National President P. H. Hogan, National President W. J. Reynolds, E. H. Kearney and President George L. Finch, and a number of songs and recitations of an unusually high order of excellence.

On Saturday morning an interesting and instructive lecture on combustion and prevention of smoke was given before the delegates at Runnels Hall by Mr. John S. Schumaker of Boston.

Immediately after the lecture the delegates and their friends were taken in special cars to Canobie Lake, a beautiful pleasure resort in New Hampshire, situated about 7 miles from Lowell. On arriving at the grounds a hotly contested and well played game of base ball took place and was a source of much enjoyment to the spectators, especially to the engineers, whose nine played great ball, and won over a nine from the supply men by a score of 8 to 5.

At 3 o'clock an excellent dinner was excellently served at the pavilion in the beautiful park grounds, and was thoroughly enjoyed by delegates and guests whose appetites had been whetted by some hours of anticipation and the bracing New Hampshire air.

After full justice had been done to the dinner the special cars were again brought into requisition and the party returned to Lowell in jolly mood, and feeling that a very successful convention had been rounded out in a highly satisfactory manner.

The Exhibition

THE first day of the convention was largely devoted to the exhibitors of engineering supplies, and was utilized by them for a display of goods that in variety and impressiveness was fully up to the stand-

ard for which Massachusetts N. A. S. E. conventions have become noted.

AT THE ENTRANCE to the exhibition hall was a display of the Crowe grates and mechanical stokers whose unique construction and obvious merits received much attention. Paul Crowe was personally in charge of the exhibit.

CHARLES A. CLAFLIN & CO. showed soot removing and tube cleaning devices, also Vulcan braided steam hose and "sure-hold" fittings. M. N. Davis was in charge.

RED STAR Boiler Compound was exhibited by James Kehoe.

THE LUNKENHEIMER CO. of Cincinnati, made an interesting, extensive and varied display of valves, oil cups and other products of standard excellence, and was represented by W. W. Beal.

THE LUMSDEN-VAN STONE CO. followed with exhibit in charge of Wm. Lumsden.

LLOYD MFG. CO. showed blow-off valves. Represented by C. M. Green.

GREENE, TWEED & CO. of New York, showed a fine line of its noted product, Palmetto Packing, in charge of F. E. Ransley, western representative.

McLEOD & HENRY CO. of Troy, N. Y., made a graphic and interesting exhibit of fire brick, illustrated by a model of a boiler setting, with John Foote showing the goods.

WILLIAM R. WINN showed oils, grease and packing, represented by J. B. Harrington.

MASON REGULATOR CO. of Boston, was represented by W. J. Kennedy.

MONARCH VALVE CO. of Warren, Mass., was represented by W. D. Hasley and Ray E. Brown.

H. W. JOHNS-MANVILLE CO. had a large and striking exhibit of its famous asbestos products and Hamilton Rubber goods that called forth deserved praise from many visitors. Messrs. James Humphreys, John F. Casey and Wm. R. Spaulding were in charge.

C. B. COBURN CO. of Lowell, had a large display, managed by Messrs. M. J. Donahoe, John J. Wade and Walter O. Flynn. Associated with them were the Challenge Tube Cleaner Co., represented by Mr. Donahoe, and the Quaker City Rubber Co., represented by H. A. Howe.

PHILADELPHIA GREASE CO. was represented by F. E. Collins, New England agent.

HART PACKING CO. of Boston, was represented by M. Hart, Thos. Walsh and Robt. Helborn.

GEO. W. KNOWLTON RUBBER CO. showed packings, and its representatives were W. S. Knowlton and A. H. Ward.

AMERICAN RADIATOR CO. had an attractive and important display of Bundy steam traps and separators. The exhibit was managed by E. M. Stevens and F. E. Reed.

THOMPSON HARDWARE CO. had a varied line of engineering supplies, emphasizing particularly, by an effective automatic working device, the ratchet wrenches and chain pipe tools manufactured by the J. H. Williams Co. of Brooklyn, N. Y. Messrs. Ray, Coburn and Leonard were the representatives.

ASHTON VALVE CO. of Boston, made an attractive and effective display of its standard safety valve and steam gages. C. W. Haughton was the representative.

EAGLE OIL AND SUPPLY CO. showed packings and boiler compound, with E. C. Janking and J. L. Hamilton as representatives.

JENKINS BROS. had an elaborate display of their noted valves, packings and rubber specialties, the exhibit being in charge of Messrs. R. H. Stiles, H. F. Fisk and J. D. Stiles.

GARLOCK PACKING CO. made a display of packings, represented by C. D. Allen, J. I. Graton, O. L. Rogers and J. V. Allen.

PRACTICAL ENGINEER occupied a booth in the center aisle and made a display of sample copies and premiums that attracted much attention and was largely patronized.

MECHANICAL RUBBER CO. of Cleveland, O., had a large and attractive display of Marco packings, which was a center of much interest to visitors during the exhibition. The company was represented by Messrs. W. E. Sanders, R. F. Blackmer and E. J. Carberry.

CROSBY STEAM GAUGE AND VALVE CO. of Boston, had an interesting display which was in charge of W. Burnham and C. Hamilton.

CRANDALL PACKING CO. of Palmyra, N. Y., had a good display, the representatives being Geo. Kendrick, G. E. B. Gibbons and E. A. Howe.

THE STRONG, CARLISLE & HAMMOND CO. of Cleveland, O., displayed a full line of its steam traps, in an exhibit managed by F. H. Evans, New England manager; Francis Evans, E. G. Crosby and F. S. Palmer, engineering expert, were also on hand.

M. T. DAVIDSON had a display of steam pumps in charge of Thomas Ellerby.

MANNING MAXWELL AND MOORE, INC., had a large and varied exhibit of its popular valves and inspirators.

CLING SURFACE CO. of Buffalo, N. Y., had an excellent display of its valuable product for increasing belt efficiency. It was represented by Chas. F. Chase and C. F. Newman.

BURKE ENGINEERING CO. of Providence, made an effective display which included the safety feed-water regulator of the Kitts Mfg. Co. of Oswego, N. Y. The companies were represented by Thos. P. Burke and William E. Cale of Burke Engineering Co., and George W. Kirk of the Kitts Mfg. Co.

FOR THE HILL Publishing Co. the representatives were M. H. Reinhart, C. M. Dibble, F. L. Johnson, Jack Armour, N. E. Robbins and Fred Low.

FEDERAL METALLIC CO. of Boston, had an interesting display of its special product, Paclite. Its merits were explained by Messrs. H. W. Rand and C. M. Wheaton.

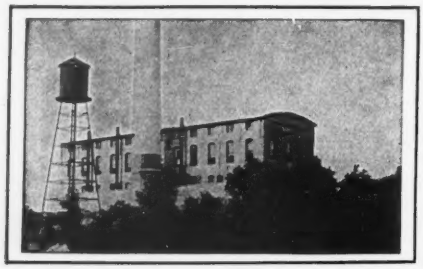
DYNA-COMO CO., INC., had a good showing of gaskets in charge of R. E. L. Osborne and W. I. Maude.

LAGONDA MANUFACTURING CO. of Springfield, O., displayed a large line of its multiple strainers and Weinland turbine tube cleaners, which were noticeably an object of much interest to the visiting engineers.

AMERICAN STEAM GAUGE AND VALVE MFG. CO. of Boston, had a large and effective display of its noted products, including a variety of steam gages, indicators and steam whistles. The exhibit was in charge of R. S. Pollard.

A UNITED DISPLAY by the New England Fire Cement Co., the Vasil Mechanical Draft Co., and the Buckeye Boiler Skimmer Co. was in charge of J. Henry Blanchard and A. Hallett, "steam specialists," Boston.

PERFECTION GRATE CO. of Springfield, Mass., displayed samples of its product, in charge of M. J. Hebbard.



Power Apparatus

In Shop and Market

New Ideas in Making, Buying and Selling

LUBRICATION IN MODERN PLANT

By R. S. Keith

DETAILED design of the modern power plant has been carried out with extreme care and, for the most part, regardless of expense for devices that look towards freedom from a general shut-down in case of accident. Effort has been made in all directions so to place the piping, valves, switchboard connections, etc., that any arrangement of groups or subgroups of power units, can be made, and the steam, exhaust and electrical connections carried out, enabling the station to send out current for power in the face of accident to any portion of the station apparatus.

This has been accomplished by the employment of bus bars on the switchboard, allowing of cross connections independent of units that are out of commission, by means of independent atmospheric exhaust connections and independent condensing units, by loop piping from the boiler, and in various other ways have details been worked out to avoid interruption of service.

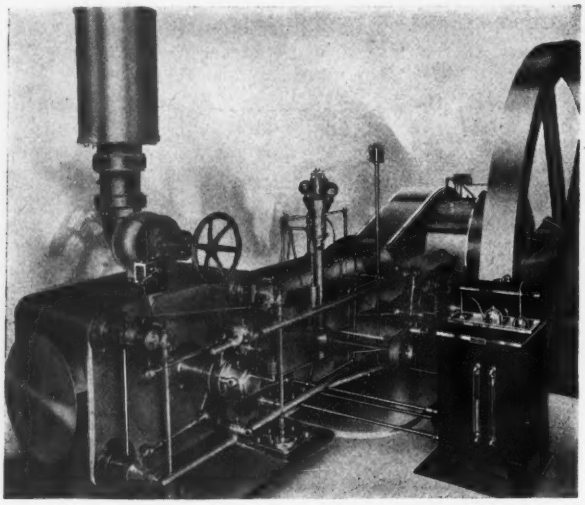


FIG. 1. RICHARDSON SYSTEM WITH A SINGLE CORLISS ENGINE

Yet in the face of this careful subdivision of the essentials of a plant, we find that oiling systems are usually put in so that the system is common to all the units, making it impossible at times to lubricate machinery, due to failure or stoppages occurring in some of the common pipe lines. The large storage reservoir, or the long header lines carrying oil to and from the engines, have been known to cause a complete shut-down of the plant. It is true that most installations have filters and steam pumps necessary for handling the oil in duplicate, but other features that would lead to trouble have been overlooked.

In harmony with the subdivision of installation, The Richardson-Phenix Co., of Milwaukee, is putting out a line of unit oiling systems, of which it is building the filter, sight feeds, the necessary pumps, and a line of clever fittings known as Union-Cinch, for piping up the oil lines on the engine. This system of lubrication obviates the necessity of connecting 2 units into a common line, or having any storage reservoirs or drainage tanks in the basement or overhead; consequently there is no need to run any pipe lines to these points. The filter is intended to be placed on the engine room floor, where it is convenient for the engineers and oilers to care for and watch the operation of the apparatus. Attached to the filter is a double-ended pump which is arranged to be driven from some part of the valve motion on the engine, and a coupling is provided for the driving connection of this pump, which may be disconnected easily; also a little handle is provided so that the pump may be operated by hand at any time.

This pump is a sturdily constructed affair, handling the dirty oil at one end and clean oil at the other. The valves and details of construction are worked out in such a way as to enable it to handle dirty oil successfully and continuously, requiring no attention from the operating force. One end of this pump is connected to a drainage receiving well, to which all the drains over the engine are piped.

This well is of cast iron, intended to be placed in or under the floor, and is provided with a substantial cap, covering a large, removable strainer, and catching the greater part of the foreign matter which drains away from the receiving bed and bearings. The pump takes this dirty oil from the receiving well and puts it into the upper back chamber of the filter, where a heating coil is provided for warming up the oil to assist in the separation of impurities and water, if any be present.

Overflow from this chamber is gradual, although the incoming oil may come in irregular quantities. This chamber is provided with a settling basin in the base for retaining such sediment as will settle at this point.

Flowing from this chamber, the oil enters a central separating chamber and goes down through a central tube, rising through water, where the separation of dirt is carried on to a still further extent. This chamber is provided with a gage glass, so that the amount of water and oil may be observed, and is also provided with an automatic overflow so the amount of water will remain constant.

Overflowing through adjustable fittings, the oil from this chamber enters the filtering cylinders proper, which are wrapped with filtering cloths in the usual manner. After passing through the cylinders, the oil comes to rest in the main storage body of the filter proper, where a cooling coil may be provided, if the quantity of oil passing through the filter is large enough to demand it, or if the temperatures are such as to make it necessary

to reduce the temperature of the oil. The heating chamber and storage room, however, are separated, which lessens the necessity for this cooling.

In these filters are embodied some very clever features of construction. For example, on top is provided a polished brass pan with inclined base, perforated in the lowest corner, so that it will drain, forming a convenient place for oil cans. The cover over the separating reservoir and filtering cylinder is removable and provided with 2 neat little handles, and the under side of this cover is arranged to carry spare filtering cloths in pockets. The heating and separating chamber is removable without the use of any tools, and when this chamber and the other are removed, the inside of the filter is easily accessible.

Arrangements for cleaning and taking care of the filter have been worked out with great care. Oil which has been filtered and which lies in the storage base of the filter is picked up by the opposite end of the pump previously mentioned and pumped up into a glass tank supported on a pipe stand. This support is provided with an inner pipe serving as an overflow carrying the oil down and out of the side opening in the base of the stand, the excess oil returning direct to the pump. Oil in the storage space is, therefore, not pumped into this glass except as used, allowing the oil to come to rest and regain its normal condition.

The glass tank on the overflow stand, is serving 2 purposes: First, an indicator of the general operation of the system; and, second, offering an easy means of determining the efficiency of action of the filter. This is a point worthy of especial mention, as the stand is in plain view of the engineer and a glance will tell how the whole system is working and the character of the oil coming through the filter.

From the base of this overflow stand, a single pipe with its branches supplies the several sight feeds about the engine, and a valve is provided in this line, not far from the overflow stand, which may be closed when the engine is shut down, retaining a tank full of oil to be used when starting up the next time.

Slight pulsations in the pipe line, due to the operation of the pump, have proved to be beneficial in keeping the feeds regular. It is well known that gravity feed cut down to a few drops a minute is liable to close off and cease to flow at all; whereas, if it is running a stream, there is usually little trouble in this direction. In the operation of systems of this nature, it is the intention to run a stream on all the bearings to be lubricated, and it is self-evident that friction, consequent loss of power, the wear on bearings which is coincident with friction and the generation of heat, will be reduced to a minimum by supplying clean, cool oil to all the bearings, by the use of such a system. It is, therefore, not only from the standpoint of the saving in necessary attendance to keep the oil cups filled, that these filters are valuable, but also from the standpoint of economy in power and repairs.

The appearance is attractive; the filter usually being painted to match the engine, and the sight feeds and Cinch fittings used in piping up the systems are especially neat and clean. The entire apparatus is backed by the Richardson guarantee of good workmanship and satisfactory operation, which in turn is backed by the established reputation of the management of the Richardson-Phenix Co.

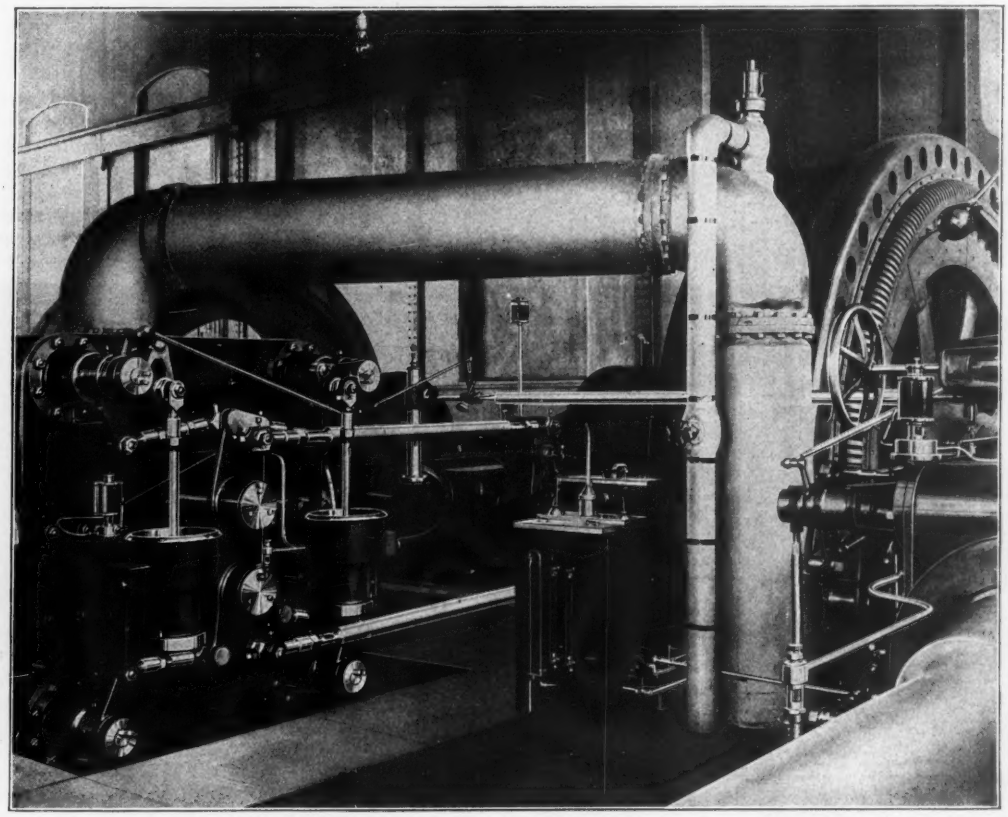


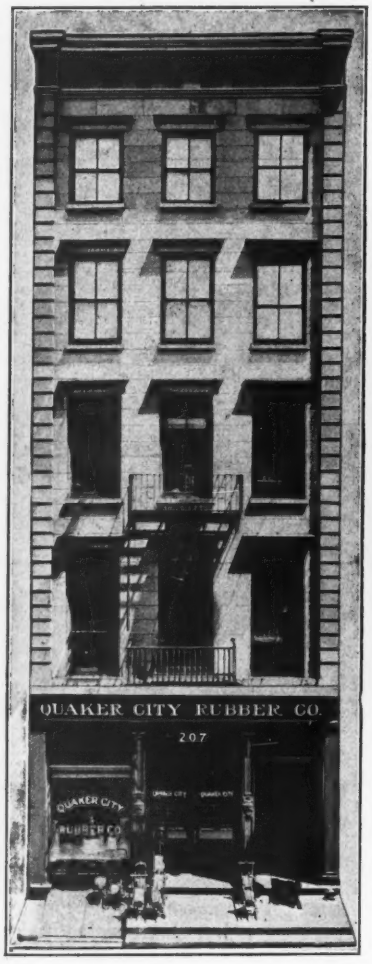
FIG. 2. THE RICHARDSON OILING SYSTEM ON A COMPOUND GENERATING UNIT

NEW YORK STORE OF QUAKER CITY RUBBER CO.

RAPID growth of the metropolitan business of the Quaker City Rubber Co., of Philadelphia, has made it necessary to open a store in New York City.

This new branch is located at 307 Fulton St., where will be found a large and complete stock of the concern's manufactures in mechanical rubber goods. This latest addition makes the third branch store, the other two being located in Chicago and Pittsburg. The home office and store is at 629 Market St., Philadelphia.

The plant of the company at Wissinonning, Philadelphia, is one of the most complete and modern rubber works in the world, every piece of machinery being new and of the latest type for the purposes for which it is used. Many of the machines are the company's own invention and are used and controlled exclusively by this concern.



NEW STORE OF THE QUAKER CITY RUBBER CO., IN NEW YORK CITY

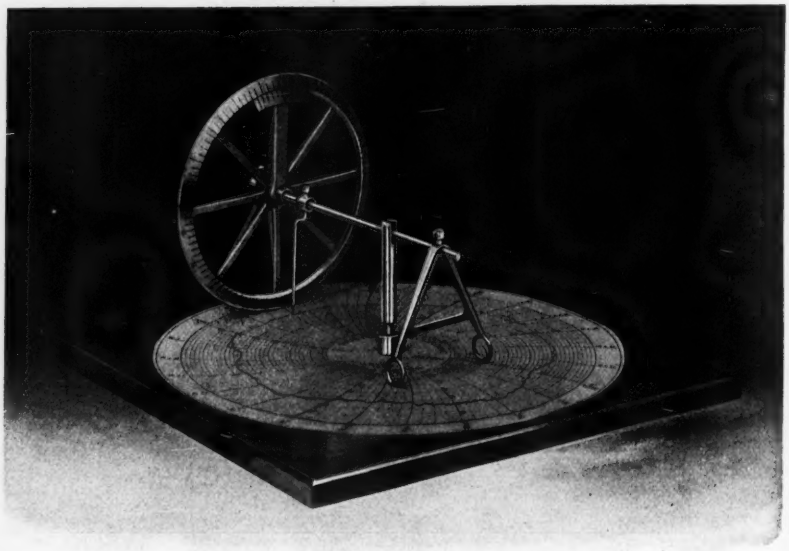
Among the specialties carried at the new store of the Quaker City Co. are Daniel's P. P. P. rod packing, Daniel's Ebonite sheet packing, Ironsides rubber belt, Ebonite steam hose, Quaker City mill hose, Quaker City double jacket fire hose and Daniel's graded valve grinders. Recently there has been added a line of Little Plumber specialties, which include a new and improved force cup and enamel cleaner, a unique style of "plumber's friend," and 2 types of toilet plungers and cleaners. All these are described in the literature of the company, which is attractive and interesting and will be sent free on request.

BRISTOL-DURAND AVERAGING INSTRUMENT

FOR the last 20 yr. the Bristol Co. has made a specialty of manufacturing automatic recording instruments for pressure, temperature, and electrical measurements, many thousand having been put into practical service.

As this class of recording instruments using circular charts has come into general use, there has developed a demand for a simple device to determine quickly the average of the record made on such charts, and the integral value for the whole 24 hr. or for the time covered by the record.

This demand has been filled by the instrument illustrated herewith, which is based upon a fundamental plan as worked out and patented by Professor W. F. Durand of Stanford University, and is constructed in accordance with a novel design recently patented by Wm. H. Bristol, president of the Bristol Co.



BRISTOL-DURAND AVERAGING INSTRUMENT FOR CIRCULAR RECORD CHARTS

The instrument can be applied for averaging records of any kind on circular charts, having uniform graduations, as, for instance, records of watts, amperes, temperature, pressure, etc. Recording instruments equipped with circular charts are therefore made available for a number of applications for which it was previously thought necessary to use instruments recording on straight lines or strip record charts. Recording differential pressure gages are coming into use for measuring velocities and volumes of liquids, air, or gas flowing in mains, and this integrating device will prove of value for quickly obtaining total volumes of flow for any given period of time.

The simple construction of the instrument is shown in the accompanying illustration. A wooden base with a metal socket is provided for supporting and

centering the chart. The socket holds a rotatable pin with a vertical slot at the top to receive the bar which carries the integrating tracer point and triangular support. The vertical groove in the rotatable pin allows the integrating wheel to roll on the chart with uniform pressure due to its own weight.

The integrating wheel is 6 in. in diameter, the rim being graduated into 100 numbered equal spaces, and is fitted with a vernier, which makes it possible to read easily with the naked eye to 0.1 of 1 division on the integrating wheel. The wheel is of such large size that it is not necessary to supply any counting device for the number of revolutions. The number of complete revolutions cannot be more than 2, even for a record of maxium size on the large 12 in. charts.

To operate the instrument, the thumb and forefinger of one hand are applied to the base of the triangular support, which is moved radially, so as to cause the tracer point to follow continually the record curve, while the chart is turned with the other hand.

By referring to a line plotted on a sheet of cross section paper furnished with the instrument, for the particular record curve that is to be measured, the total reading for the entire 24 hr. may be taken off directly.

The instrument is adapted for integrating charts with either straight or curved radial time arcs. The correction necessary for radial time arcs which are curved may be made, after completely tracing the record, by returning the tracing point to a point on the chart having the same radius as the starting point the movement of the tracing point being along an arc corresponding to the curved radial time arc.

NOISELESS VALVE FOR VACUUM HEATING SYSTEMS

VACUUM heating is well known and has come to stay, as it is considered an efficient and economical method of heating. Two great faults that have been encountered in the erection of vacuum heating systems are claimed to be done away with by the installation of the Monash radifier: 1, the noise caused by the chattering of the float. 2, the fact that a valve of this type cannot be cleaned without removing it from the radiator, coils or other heating units to which it has been attached.

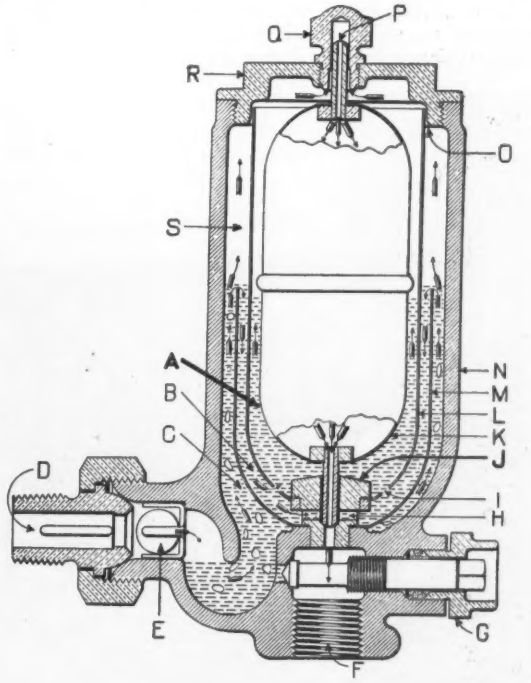
In the construction of the Monash radifier, as herewith illustrated, the arrow letter A points to the still body of water in which the float is incased, preventing the chattering of the float due to air or water currents. This renders the valve noiseless, and for schools, hospitals, hotels, theaters, churches, and buildings of that class where quietude is essential, it has been used with the best of results..

The arrow letter J points to the seat which can be unscrewed and the interior of the valve taken out and thoroughly cleaned without disconnecting the valve from the radiator, coils or heating units. This valve is covered by patents, and, as we understand, is in the service of some of the most prominent buildings throughout the United States.

The valve is attached to the return end of the radiator or heating device by the union nipple, D, and to the return pipe at the outlet, F, which is connected to the vacuum pump. The air and water of condensation are drawn by the vacuum from the radiator into the radifier through the inlet, D, past the ball check, E, down into the goose-neck trap where any core sand, heavy dirt or foreign matter is deposited, which may be blown or drawn through the bypass valve into the return through the outlet, F.

Air and water of condensation pass upward in chamber C, when the air separates from the water and is drawn through chamber S and opening O then on to the hollow float guide pin, P, through float K down to the return through outlet F.

Water of condensation being drawn up into the body of the valve, rises to the upper edge of the outer shell, M, flooding chamber B and also gradually filling chamber A by slowly passing through openings I, which being of small dimension, prevent the sudden rush of water into the chamber A thus breaking the current or force of the water, preventing the chattering of the float, due to air or water currents, which is the essential feature in an absolutely noiseless float valve.



SECTIONAL VIEW OF MONASH RADIFIER

Water gradually rises around the float to a point near the seam, when it raises float K thereby opening the discharge passage through the valve seat, J. While the valve is open chamber B is drained by the water pushing through opening H in valve seat J and to the return pipe through outlet F, and since the discharge is over the top of shell M, the water, oil, grease or floating matter is skimmed and is carried off with the water.

The receding water in chamber A keeps the float buoyant until the valve is closed, thereby insuring a noiseless operation of the float.

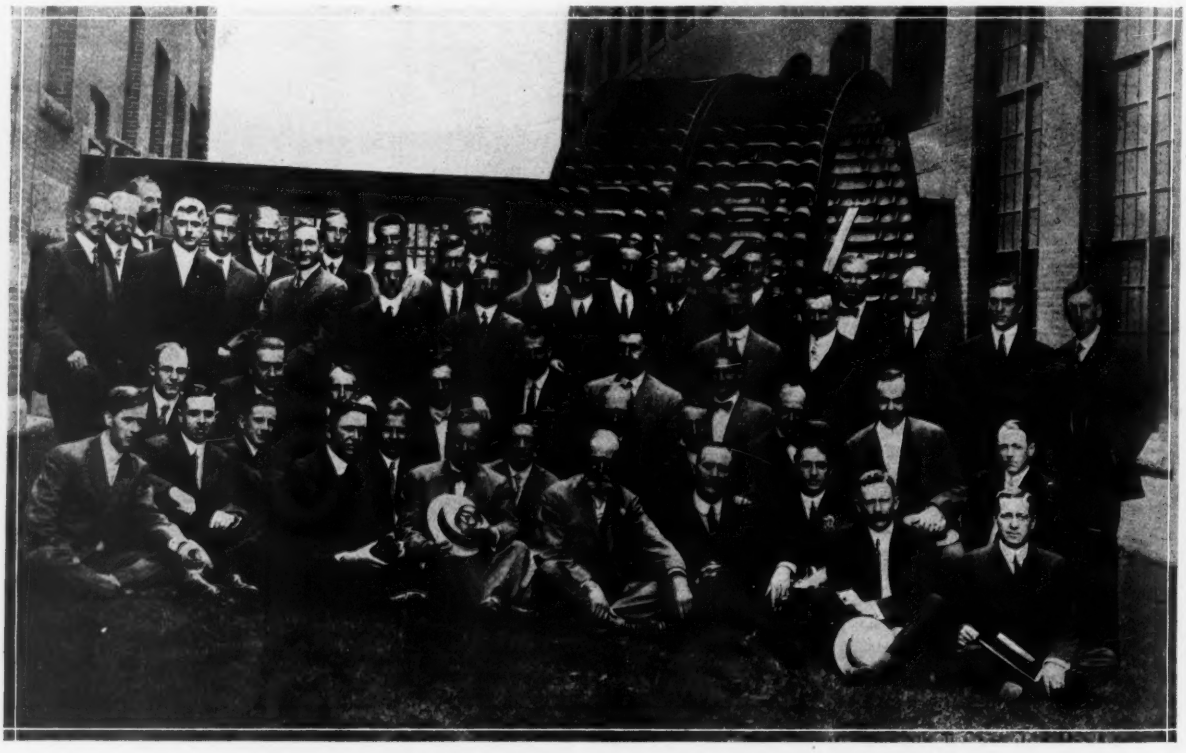
Phospher bronze ball check ,E is held in place by a copper basket and seating in the union nipple prevents the vacuum in the radiator from reacting on the vacuum in the return when the radiator supply valve is closed. To clean the passage way of the float, cap Q may be unscrewed and a wire forced through the openings in the float guide stem.

To clean the valve, remove cover R, when the float can then be taken out and, with the special wrench, seat J can be unscrewed and the interior of

the entire valve removed and thoroughly cleaned, there being no sharp corners or hidden channels where any foreign substances could lodge. Another feature which commends the valve to the user is that it can be cleaned at any and all times without disconnecting it from the radiator, coils or heating units.

After the valve and shells have been thoroughly cleaned, they are again easily assembled and the valve sealed, as the cover screws up readily, being fitted perfectly to the body of the valve. The bypass valve is protected by a locked shield feature, G, which prevents unauthorized parties from tampering with the valve, keeping the control of the system in the hands of the proper parties.

Monash-Younker Co. is the manufacturer of this valve and the increasing demand has compelled the company to move its factory to 1407-1417 Jackson Blvd., Chicago, where more space is available.



HEADS OF DEPARTMENTS AND SALES FORCE OF B. F. STURTEVANT CO.

FAN SALESMEN'S CONVENTION

THE B. F. Sturtevant Co., Hyde Park, Mass., large manufacturer of fans, blowers, fuel economizers, and mechanical drafting apparatus is so well known to everybody in the manufacturing line, and its salesmen are known personally to so many architects and engineers, that it is a matter of interest to note its salesmen's convention held June 15 to 18.

The branch office managers and principal salesmen from all over the country assembled at the works and general offices at Hyde Park and spent 4 very busy days in going over general business matters. Their evenings were enlivened by banquets and other social features.

The last day of the convention closed by a delightful sail down the harbor and an afternoon and evening as the guests at the Cohasset home of E. N. Foss, treasurer of the company. The convention was marked by great enthusiasm as the company has just finished, July 1, the largest business year in its history. In the illustration the large multivane wheels in the background are for tunnel ventilation. The small multivane wheels held by the men are used in the Sturtevant Ready-to-Run Electric Ventilating Sets.

STEAM DEVELOPMENT

WONDERFUL growth of the steam engine is evidenced by a letter recently received from the Penberthy Injector Co., of Detroit, stating that on March 29, 1910, injector number 600,000 was stamped and recorded ready for delivery.

When we stop to consider that the above company has since 1887 made 600,000 of its automatic injectors, we obtain some idea of the large horsepower of boilers which must be in operation at the present time, for it has been carefully estimated that 600,000, size 2½ in. GG Penberthy injectors would force into a boiler against 90 to 100 lb. pressure over 1/3 of the amount of water that is constantly going over Niagara Falls, which is approximately 125,000,000 to 150,000,000 gal. a minute. This when transformed to steam at 70 lb. pressure is sufficient to develop power amounting to approximately 700,748,661 hp., or very near 5 times the estimated horsepower of the world's steam machinery.

Should the growth of steam power increase in the next hundred years as it has in the past, we shall have as a result a combined horsepower capable of performing work the magnitude of which would be so great as to be almost inconceivable to the average person of to-day. The likelihood of the development in steam power during the next century is through increased efficiency.

NEWS NOTES

THE BERLIN CONSTRUCTION CO. has received the contract for rebuilding the fan shop of The Green Fuel Economizer Co., at Matteawan, N. Y., which was almost totally destroyed by fire some weeks ago. It is expected to have the new building erected and complete, ready for occupancy, about the middle of August. The new shop will have about 25 per cent more floor space than the old shop, including a test room fully equipped with chambers, gages, etc., suitable for making exhaustive tests on the capacity, pressure and efficiency of the improved fans built by this concern for heating and ventilating, mechanical draft, and other services. The new building will be of steel construction throughout and will be heated by the hot blast system, with frequent outlets near the floor to secure uniform distribution of the heat. This system has been applied by The Green Fuel Economizer Co. with great success in several buildings that were peculiarly difficult to heat, such, for instance, as the new foundry of the Waterbury Castings Co., where the wall surface is almost entirely of glass.

MANUFACTURE OF THE Richardson oil pumps and lubricating specialties will in future be carried on in connection with the building of the Phenix pumps—heretofore manufactured in Chicago. W. E. Richardson will devote his entire time to the development and furthering of mutual business interests, acting as president and general manager. The active colleagues of Mr. Richardson will continue in their several capacities, assisting to merit a continuation of the many past favors extended both companies.

All patrons and friends of the Sight Feed Oil Pump Co., of Milwaukee, and the Phenix Lubricator Co., of Chicago, will find them as the Richardson-Phenix Co., at Milwaukee, Wis., where both plants will be combined in the new factory building of the Sight Feed Oil Pump Co.

SYLVESTER S. HOWELL has become associated with Paul M. Chamberlain, Engineer, Marquette Building, Chicago, as the firm of Chamberlain & Howell, to carry on the designing and consulting engineering practice established by Mr. Chamberlain. Mr. Howell's many friends will welcome this move as giving wider latitude for his talents and varied experience. Mr. Howell received his collegiate education at the Iowa State College, and since 1887 has given his attention to engineering matters. His experience involves work with the old Thomson-Houston Co. in installation; the Westinghouse Electric and Manufacturing Co. in its great installation at the World's Fair in Chicago; the Standard Oil Co. of Indiana in electric lighting plant installations; the Patton Motor Co. with its gas engine, generator, storage-battery, motor units for railways; the Green Fuel Economizer Co. in effecting power plant economies; the Holtzer Cabot Electric Co.; the Carbolite Gas and Iron Co. of Hammond; the Calumet Portland Cement Co. of Chicago, for which he built a thousand barrel cement mill; the American Blower Co. as Chicago manager, in which capacity he designed and installed many heating and ventilating plants, mechanical draft, and drying installations; the Iowa Dairy Separator Co. of Waterloo, for whom he was consulting engineer, designing its large central heating plant; the Underfeed Stoker Co. of America, in special engineering and designing, which position he resigns to form the connection above announced.

THOSE WHO ARE INTERESTED in visiting Chicago during the next few months will be glad to know of an arrangement made by the Chicago Association of Commerce for reduced fares. The territory covered includes Indiana, Kentucky, Ohio, Michigan, Illinois and Pennsylvania. Purchasing dates are Sept. 10 and Sept. 16 in this territory. From the West and Southwest, including Texas, Oklahoma, Kansas, Arkansas, North and South Dakota, Minnesota, Missouri and some points in Louisiana, Mississippi and Tennessee, a round trip ticket is sold for a fare and a half up to Sept. 30 good to return until Oct. 31.

ARRANGEMENTS ARE UNDER WAY and progressing rapidly for the exhibit of the National Exhibitors' Association at Rochester, N. Y., Sept. 12-17, in connection with the convention of the N. A. S. E. Convention headquarters will be at the Hotel Seneca, one block from the exhibit hall. The exhibit and convention will be in the Armory Building, located in the heart of Rochester, a city of 210,000 inhabitants and having 1140 manufacturing establishments besides being within convenient reaching distance of a large manufacturing population in other cities. The floor space available will be 21,600 sq. ft. Arrangements for the exhibit are in the hands of Harry H. Ashton, care of Ashton Valve Co., Boston, Mass., and applications for space should be sent to him promptly in order to be sure of securing it.

THE UNIVERSAL LUBRICATOR CO., of Philadelphia, has purchased the factory, patents and business of the Philadelphia Lubricating & Mfg. Co., of the same city, and has moved the plant to larger quarters, thus increasing the manufacturing facilities and adding special machinery. The business of manufacturing the Philadelphia Compressed Air Grease Cups will be carried on as before and orders can be supplied promptly in large quantities.

AT THE RECENT CONVENTION of the International Association for the Prevention of Smoke, at Minneapolis, Minn., R. S. Riley, President of the American Ship Windlass Co., Providence, R. I., read an instructive paper on "Taylor Stokers and Steam Boiler Efficiency," in which he showed by numerous illustrations the principles of construction and operation in their relation to increased efficiency.

WALTER B. SNOW, publicity engineer, Boston, Mass., has added to his staff, H. Ross Callaway, a graduate of the Massachusetts Institute of Technology, and late assistant to the mechanical engineer of the New York Edison Co.

AT A MEETING of the board of directors of The Petroleum Iron Works Co., of Sharon, Pa., held July 11, 1910, C. H. Todd of Washington, Pa., was elected president in the place of E. G. Wright, resigned. Mr. Todd, who was one of the founders of The Petroleum Iron Works Co., and who will be in active charge of the company's affairs, is well and favorably known, especially in the eastern and southwestern oil fields. The directors reported the plant as running full, with sufficient orders booked to insure a steady run for several months, and the financial position of the company as unusually strong.

SPECIFICATIONS ARE OUT and bids are invited for a new steam plant for the Ellsworth Building, 355 Dearborn St., Chicago. This will include boilers, Dutch oven furnaces, piping and headers, valves, feed-water heater, water purifier or softener, traps, separators and other equipment for a complete plant.

USEFUL INFORMATION for those dealing with piping is given on cards sent out by Kroeschell Bros. Co., 440 West Erie St., Chicago. On one card recently received is a complete table of data in regard to piping, giving dimensions, capacities and safe pressures. On another is a rule for finding the length between centers of offset, fittings for different angles, and sizes of pipe. A full set of these cards will be furnished to anybody applying to Kroeschell Bros. Co. for them.

THE ASPINOOK CO. is having plans and specifications prepared by Chas. T. Main, for extensive additions and improvements to the power plant of its print, dye and bleaching works at Jewett City, Conn. These include the installation of 2 new horizontal return tubular boilers, 78 in. in diameter, with 3.5 in. tubes 20 ft. long, developing 218 hp. each, and a horizontal cross-compound belted engine rated at 425 hp., and the revamping of the power piping.

ERIE CITY IRON WORKS reports business in splendid condition. Over 60,000 hp. of the new Erie City water-tube boiler have been sold and over 20,000 installed, and 20,000 hp. of the Lenz engine has been contracted for.

THE SKINNER ENGINE CO., finds its business increasing so rapidly that extensive plans are under way for the enlargement of the plant. A new three story office building will be erected, 90 by 40 ft., finished in oak and mahogany, and provided with ventilation giving hot or cold air, washed to remove all impurities. An extension to the shops 100 ft. wide by 150 ft. deep and a foundry 70 by 200 ft. is to be erected. Altogether an expenditure of $500,000 will be made this season in increasing the plant.

C. W. HUNT CO., New York, has opened offiices at State Bank Building, Richmond, Va., and also 607 Rhodes Building, Atlanta, Ga., with W. F. Lee, for several years preliminary engineer to the company, in supervision.

CATALOG NOTES

IF YOU EVER FIGURE HORSEPOWER, you will find the Mayo Mean Effective Pressure Tables invaluable. Mr. Mayo, who is designer for the Hooven-Owens-Rentschler Co., of Hamilton, O., has arranged these tables for single cylinder and for compound engines, condensing and non-condensing, so that the probable mean effective pressure for any ratio of expansion and any initial pressure is seen at a glance. The price of the two tables is 50 cents, but as a special favor to Pratical Engineer, the Hooven-Owens-Rentschler Co. has agreed to send them to any of our readers who enclose 10 cents for postage. Letters should be sent to the company at Hamilton, O., mentioning this offer.

THE EXHAUST STEAM HEATING ENCYCLOPEDIA shows how exhaust steam is utilized according to different systems for this important work. It covers the apparatus needed in a heating system according to the Van Auken, the Paul, the Baldwin, the Haines, the Donnelley, the Dexter, the Illinois Engineering Co., the Peck, the Keystone, the Dunham, the Simonds, the Broomell, the Webster, the Monash-Younker and other systems, showing the arrangements of apparatus and how the Cochrane Steam Stack and Cutout Valve, Heater and Receiver is applied in each of these systems to simplify the piping. Interesting cross sectional views show the simple construction of this heater and what it accomplishes with a minimum of parts and in minimum space. The book gives also a large number of tables of data applying to the heating of buildings. The present book is the second edition. It has been revised and enlarged since the first one and includes descriptions and illustrations of several systems not found in the first edition. It is what its name states, an encyclopedia of exhaust steam heating, of 120 pages, beautifully printed, and a valuable book for anyone who has to do with heating power plants.

The new design of the heater and receiver has 2 valves, 1 for closing off communication between separator and body of the heater, and the other to close the passage from the trap which drains the separator to the body of the heater. This makes it possible to open the heater for cleaning or inspection while keeping the separator in service. Copy of this book may be had by writing to the Harrison Safety Boiler Works, Philadelphia, Pa.

FROM THE PENNSYLVANIA FLEXIBLE METALLIC TUBING CO. comes an interesting and instructive booklet on Metal Hose. This is not metal reinforcement, but hose made of all metal and arranged with a double interlocking joint so that it is suitable for the highest pressures of steam, air or any liquid. The booklet, which can be had by writing to the company at 1305 Arch St., Philadelphia, shows the construction and the different uses for which the hose is adapted, also the devices by which connection is made to different classes of apparatus. This tubing is handled in the Western territory by the U. S. Flexible Metallic Tubing Co., with head office at Los Angeles, Cal.

BULLETIN NO. 1070 of the Allis-Chalmers Co., entitled Barometric Condensers, Type B, tells of the interior construction of which includes no bolts, screws, rivets, or any parts that can get out of place, and when once set up and put in operation, will give satisfactory service as long as cast iron will last.

Copies of this bulletin can be had on application to the company.

FROM THE DE LAVAL STEAM TURBINE CO., of Trenton, N. J., comes Catalog B describing High Efficiency Centrifugal Pumps, but it is much more than a catalog. It describes the present status of the centrifugal pump, showing the characteristics of this type of machine, how the pumps are tested to determine their characteristics, a series of curves from tests on different sizes of the De Laval pump which show fully just what the pump will do and how close it comes to meeting the conditions for which it is designed. Not only is the construction of pumps of this type fully considered, but the different details are explained and the reasons why certain parts are given the shapes which they have. Also the general question of the use of pumps for different purposes and the types for which they are adapted, the multistage pump, why it is made and how, methods of driving the kind of pumps adapted for special services, and the services for which centrifugal pumps are especially adapted, are all treated at length and in understandable language. The book is handsomely illustrated and it will be a pleasure for evervone who receives it to have it in his library as well as to read it for the information that it contains.

CARB-OX SPECIALTIES for keeping track of combustion conditions in the firebox and combustion chamber are described in a new pamphlet received from the Carb-Ox Co., Rogers Park, Chicago.

THE NEW BULLETIN NO. 11, issued by the Engineering Department of the National Electric Lamp Association, describes the Mazda lamps as made for series use in street lighting and gives tables of the sizes, candlepower, dimensions and efficiency of these lamps. To anybody interested in street lighting, it is a pamphlet worth owning. The address is Cleveland, Ohio.

AN INTERESTING WATER WEIGHER, made by the Kennicott Water Softener Co., Chicago Heights, Ill., is described in the bulletins Nos. 36 and 37 issued by that company. It is, in fact, a measurer rather than a weigher, but it is accurately calibrated so that it gives the weight within ½ of 1 per cent. It is made in sizes with capacity from 750 lb. to 1,000,000 lb. of water an hour.

WORTHINGTON CONDENSING MACHINERY and Worthington pop valve pressure pumps, as made by Henry R. Worthington, of New York City, are described in catalogs just received which give full illustrations, dimensions and detailed description.

TRANSMISSION LINES requires the best of material, for the failure of a transmission line is liable to

produce disastrous results. The line of perfected appliances for construction, maintenance and operation of transmission lines, railways and line systems, shown in Catalog No. 8 of the Ohio Brass Co., is, therefore, interesting and important. It includes all material necessary for the construction of a trolley or transmission line for any service and also for the construction of railway return lines. The catalog itself is as complete and satisfactory as the line of construction material. It illustrates and gives dimensions where needed of all apparatus as well as list price. Besides its completeness as to lists of apparatus needed, the usefulness of the catalog is increased by tables giving properties of bare and insulated copper wire, copper and aluminum cables, the power required for traction, dimensions of piping and other data needed in calculation of transmission lines. A complete code adds to the convenience of ordering material and a complete index to the convenience of the catalog. A copy of this interesting book can be had by writing to the Ohio Brass Co., Mansfield, Ohio.

IDEAL PISTON ROD PACKING, made by the Regal Packing Co., of New York, is of granular form made from soft metal and encased loosely in a tube so that it is applied in the same way as a round fibrous packing. After a bit of use these granules solidify and form a mass about the rod, but do not pack tight enough so but that they can be broken up when the packing is removed and used over again. The way in which the packing operates and the advantages of its use are shown in a convenient booklet which can be had by writing to the company at 136 Liberty St., New York.

FROM THE RICHARDSON-PHENIX CO. come 2 interesting bulletins, No. 113 describing the Richardson plunger pumps for oiling systems, the other on the Richardson complete automatic oiling and filtering system, describing the arrangement of this system for taking care of dirty oil and transforming it into clean oil. Installations of different systems are shown and the details of the operation clearly illustrated. Copies of these interesting bulletins can be had by writing to The Richardson-Phenix Co., at Milwaukee, Wis.

TRADE NOTES

THE ACHESON OILDAG CO. of Niagara Falls, N. Y., has purchased a factory site of 30 acres at Port Huron, Mich., and will erect there its prospective plant. Port Huron was selected as the site because of its comparatively pure water and excellent shipping facilities.

Oildag has made phenomenal progress in the matter of establishing itself as a superlative lubricant and conserver of petroleum lubricating oils, but owing to the past limited manufacturing capacity of the company, the price was of necessity high and retarded its rapid introduction into general lubrication.

On the first of July, the Acheson Oildag Co. reduced the selling price of Oildag to approximately 60 per cent of that previously quoted, thereby bringing it down to a price, when bought in quantity, of considerably less per gallon than that of the oil with which it is mixed. The presence of the deflocculated graphite in the oil makes each gallon equal to 2 to 4 gal. of plain oil.

This policy of rapid reduction in selling price in order that the manufacturing interests may quickly obtain the benefits to be derived, is closely following that formerly adopted by Dr. Acheson, when he was president of The Carborundum Co. when he made the rather spectacular drop in the selling price of Carborundum from $800 a pound to 10 cents a pound, thereby causing it to become a staple commodity.

AMONG THE STEAM SPECIALTY DEALERS who are building up a big trade in Swartwout Cast-Iron exhaust heads, Centrifugal separators, and Automatic water gages, are the following: Rollins Steam Specialty & Valve Co., Chicago, Ill.; V. Bacigalupo, Richmond, Va.; W. M. Pattison Supply Co., Cleveland, Ohio; Laib Co., Louisville, Ky.; Pittsburg Piping & Equipment Co., Pittsburg, Pa.; United Supply Co., Saginaw, Mich.; Mau-Sherwood Supply Co., Cleveland, Ohio; New Jersey Engineering & Supply Co., Passaic, N. J.; Advance Machinery & Supply Co., Denver, Colo.; Nightingale & Childs Co., Boston, Mass.; Marshall-Wells Hardware Co., Duluth, Minn.

FROM THE MURRAY IRON WORKS, Burlington, Iowa, comes an interesting as well as handsome medal made into the form of a watch fob. This shows the trade mark which has been adopted, of the shears having as handles the Murray engine and boiler, actuating the blades, "economy" and "efficiency," to cut the coal bill in half. The fob can be had by writing to the Murray Iron Works at Burlington for it.

FOR THOSE USING steam engine indicators a convenient device for making connection of the indicator cord to the standard on the crosshead has been perfected by the Trill Indicator Co., of Corry, Pa. It is called the Trill Catch-'em-quick indicator hook. If you have had trouble in hitching on your indicator the Trill Indicator Co. can help you out and will be glad to do so if you write and ask about this device.

ONE OF THE MOST attractive booths in the exhibit hall during the National Electric Light Convention at St. Louis was that occupied by the Westinghouse Electric & Mfg. Co., the Westinghouse Machine Co. and the Westinghouse Lamp Co. The display consisted of a number of Type S motors for industrial service, single phase and polyphase motors, also squirrel cage secondary induction motors. Small power motors in sizes from

1/12 to ¼ hp., for both alternating and direct current, made up part of the exhibit. Other power appliances such as motor starters, lightning arresters, mercury rectifiers, voltage regulators, etc., made by the Electric Co., were given prominence. The Lamp Co. featured its newest type of Tungsten lamps which has a continuous filament. These are made in sizes from 500 to 25 watts and were shown both lighted and dead in the exhibit booth.

WALTER L. FLOWER COMPANY, manufacturer of the Acme Oil Filter advises having sold 66 filters during the month of June. Most of these filters for export.

AS TO LUBRICATION, the Raleigh Coal & Coke Co., of Beckley, W. Va., writing to the United States Mica Co. of Chicago, say: "We use Mica Flake Lubricant for the purpose of lubricating our mine car wheels, and are very glad to advise you that our experience with

it has been very satisfactory, as the use of the Mica Flake has greatly reduced our oil expense and has enabled us to haul more cars."

THE ALLIS-CHALMERS CO. has just secured from the United States Steel Corporation additional orders for 6 gas engine driven electrical units which will increase the Corporation's power plant at Gary, Indiana, 25 per cent. The 25 engines which the Allis-Chalmers Co. has installed in this plant, and the order just secured, will make a total of 31 gas engines with a combined capacity of 150,000 hp., which will be the largest power plant of its kind in the world. These units will operate on blast furnace gas. In addition to this the Allis-Chalmers Co. has secured from the American Steel & Wire Co. order for 2 large gas engines for its central furnaces at Cleveland, Ohio, of the same capacity as the engines for the Gary plant.

THE L. J. WING MFG. CO., 90 West St., New York, has recently sold the D., L. & W. R. R. Co. for its Bliss and Auchincloss Collieries at Nanticoke, Penn., 28 20-in. Typhoon Turbine Blowers for forced draft on 3500 hp. of boilers.

THE INTERNATIONAL ACHESON GRAPHITE CO., of Niagara Falls, N. Y., has arranged to erect a very substantial and large addition to its works on the lands of the Niagara Falls Power Co. in that city. The addition will be in the nature of a furnace room, which will afford capacity for 10 or 12 new furnaces. The buildings will be of brick and steel construction and erected to the west of its present works, where there is ample room for still further enlargement. The additional furnaces will make possible a very large increase in the output of graphite, and is indicative of the constantly increasing recognition of the value of the products of the company. These products are electrodes for electrochemical, metallurgical and electrical purposes, and powdered graphite for dry cell filler, paint pigment, powder glazing, lead pencils, firearms lubrication, general lubrication, electrotypers' moulding and polishing leads, etc. It will thus be seen that electric furnace graphite has acquired prominence in all fields where natural graphite has been used.

SWARTWOUT SPECIALTIES are going like hot cakes. The Ohio Blower Co. recently reported for 1 month's sales 95 cast-iron exhaust heads, 39 steam and oil separators, and 38 automatic safety water gages.

PRACTICAL ENGINEER CLASSIFIED ADVERTISEMENTS

Advertisements in this section are inserted under regular headings at the rates of 40 cents per line. About nine words make a line. No display type is allowed, but the first three words may be set in capital letters. Minimum space sold, two lines.

Under classification, "Positions Wanted," advertisements not exceeding four lines will be inserted for subscribers once free of charge.

To insure proper classification, copy must reach this office on or before the 15th of month preceding publication.

Positions Wanted

POSITION WANTED—Eight years' experience in large Central Station, with steam and electrical work. Want to take charge of a small plant. Hold first class license in large city. Address Box 139, Practical Engineer. 8-2

POSITION WANTED—With Water Wks. Co. as Chief Engineer or Superintendent by a thoroughly practical man of long experience; is a hustler and willing to go anywhere. First class reference furnished. Box 138. 8-2

POSITIONS WANTED—Young man, 18 yrs. of age, wishes position as oiler, helper or other minor position in power plant, where he may learn; willing to begin at bottom; some experience; moral habits, A-1 references. Address Raymond Siders, Bidwell, Ohio. Box 20. 8-2

POSITION WANTED by young man as assistant engineer in ice plant, has four years' experience among boilers, engines, pumps, etc. Address Box 140, Practical Engineer. 8-2

Help Wanted

WANTED SALESMEN—Calling on plants using Steam for power to carry an excellent article as a side line. Write for particulars. Address Box 137, Practical Engineer. 8-tf

WE HAVE a stunning proposition for an engineer in every town or city. Little time required. Will not interfere with regular work. Write for particulars. Address Box 136, Practical Engineer. 8-tf

AGENTS WANTED to sell Burgmann celebrated engine packings in territories not yet covered. See our advertisement on page 16 of this issue.

WANTED—AN ENGINEER in each town to sell the best metallic packing for steam, air, gas and ammonia. Write Ideal Metallic Packing Co., South Stillwater, Minn. 5-tf

ENGINEERS AND MECHANICS—To make big money selling Incomparable "ZIZ" Hand Soap. A 10-cent can will instantly remove more dirt and stains from the hands than four cakes of any soap made, and it will not injure the most delicate skin. Small sample free. Byram Mfg. Co., Box 3133, Boston, Mass. 4-tf

A LARGE ELECTRICAL CONCERN has vacancy for a superintendent of their plant. Product is both light and heavy; about half of output consists of ammonia compressors. Applicant must have good executive ability, be able to combine aggressiveness with diplomacy and must assume charge of entire work. A permanent position is assured to the right man. Address Box 135, Practical Engineer. 6-3

For Sale

FOR SALE—Three Return Tubular Boilers, manufactured by Ritter Bros., Buffalo, N. Y. Drums 72 in. by 16 ft. Each Boiler wtih sixty-six 4 inch Tubes. Inspected by Travelers Indemnity Co. of Hartford, Conn. 93 lbs. steam pressure. Boilers in good condition. Can be delivered in two or three months, and seen in operation at Buffalo Bolt Company's plant, North Tonawanda, N. Y. 8-6

FOR SALE—COMPLETE SETS OF CASTINGS and material for neatly designed horizontal 1-16 Hp. steam engine. Engine has governor on cut off principle, rotary valve and adjustment for wear. A novice can build one with the help of our blue prints and instruction sheets. Castings and material, $1.50. Blue prints and instructions, 25 cents. Pat Novelty Co., Box 193, Elgin, Ill. 8-1

Patents and Patent Attorneys

FREE BOOKLET—All about patents and their cost. Shepherd & Campbell, Patent Attorneys, 500 M. Victor Bldg., Washington, D. C. 5-tf

DIETERICH'S 50 PERPETUAL MOTIONS—100 mechanical movements; books tell about perpetual motion and how to obtain patents; by mail for 25 cents, postage or coin. F. Dieterich & Co., Patent Lawyers, 64 Oray Block, Washington, D. C. 4-tf

PATENTS—C. L. Parker, late Examiner U. S. Patent Office, Attorney-at-Law and Solicitor of Patents. Patents secured promptly and with special regard to the legal protection of the invention. Handbook for inventors sent upon request. 186 McGill Building, Washington, D. C. 4-tf

Miscellaneous

DRY BATTERIES EXHAUSTED can be renewed for 2 cents each. Simple, scientific instructions 25 cents. Dirigo Sales Co., Bath, Maine. 7-3

GREASE, OIL AND LUBRICATE your loose pulleys and shafting with graphite, mica or asbestos candles; no drip; no dirt; economical. Swain Lubricator Company, 250 Lake St., Chicago. 5-6

EVERY ENGINEER should know about the new system of Vacuum Heating which can be installed without payment of royalty. Particulars will be cheerfully furnished. T. L. Reeder, 1413 W. Jackson Blvd., Chicago.